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Table of Contents

Overview	3
Initial History	4
Locating the Manuscript.....	4
Contacting the Archimedes Team and Visit to Blantyre.....	4
Funding and the Missing Diary Pages	5
Livingstone's Letter from Bambarre.....	5
Project Planning.....	5
Setting the Stage	6
Permission and Conservation.....	6
Project Planning	6
Spectral Imaging in Scotland	7
Imaging Set-Up	7
Data Logging, Collection, and Copying.....	9
Personnel and Activities	10
Imaging Schedule and Objectives.....	11
Spectral Image Processing.....	12
Principal Component Analysis (PCA)	12
Spectral Ratio and Pseudocolor Rendering.....	13
Processing Objectives and Results	13
Data Management	14
Preliminary Data Management	14
"Data Scrubbing"	14
Creating the Data Archive.....	15
Restoring the Text.....	16
Data Hosting	16
Creating a Publication Template and XML Encoding	16
Transcription Outcomes.....	17
The Electronic Edition	18
Analysis to Dissemination.....	19
Preliminary Data Analysis	19
Dissemination	20
Release of Project Results and the UK Tour	20
Lessons Learned and Future Projects.....	21
Challenges.....	21
1. Project Funding.....	21
2. Communication	22
3. File Naming	22
Future Projects and Follow-Up Work.....	23
Appendices – List of Items	24

Overview

The Nyangwe Diary of David Livingstone: Restoring the Text represents an eighteen-month collaborative, interdisciplinary, international endeavor to use advanced imaging technology and digital publishing to restore and make freely available online the 1871 Field Diary (also called the Nyangwe Diary) of David Livingstone, the celebrated and legendary Victorian explorer of Africa. The project has been funded by the U.S. National Endowment for the Humanities with a supplemental grant provided by the British Academy.

In 1871, Livingstone spent five months stranded in a small village in the Congo called Nyangwe. He had run out of writing paper and had nearly run out of ink, so he improvised the materials for his diary by writing over an old copy of *The Standard* newspaper with ink made from the seeds of a local berry. In the intervening 140 years large portions of this text – a major Scottish national treasure and an important primary resource for the study of African history and the history of the British Empire – have faded to the point of illegibility, a problem compounded by the continuing prominence of the newsprint over which Livingstone wrote. Our research team has used spectral imaging and processing to recover nearly the entire text of the diary, and we have subsequently released our results as two born-digital products, both of them published by the UCLA Digital Library:

1. *Livingstone's 1871 Field Diary: A Multispectral Critical Edition*
(<http://livingstone.library.ucla.edu/1871diary/>)

2. *Livingstone Spectral Image Archive: TIFFs, Metadata, XML Transcriptions*
(http://livingstone.library.ucla.edu/livingstone_archive/)

The text that follows describes our project activities, our accomplishments, the public reception of our work, and the future initiatives that this NEH-funded project has set into motion. The narrative is drawn largely from the “Project History & Archive” section of product #1, above (see http://livingstone.library.ucla.edu/1871diary/initial_history.htm and the pages that follow). This section of the website was designed with an eye to meeting both the NEH White Paper and Final Performance Report requirements, and, additionally, has received the input of nearly each team member and stakeholder, making it an exceptionally collaborative product. By treating this section as a fundamental part of our website, we have also sought to make our work transparent, to detail for scholars and the public the means by which we achieved our results, and to create a permanent, integrated resource by which others might learn from our lessons and build our efforts.

That said, there are two primary differences between the narrative submitted here and that available online. The online narrative is hyperlinked where relevant, includes an array of images and illustrations, and provides access to over 60 downloadable documents and files produced in the course of the project that collectively provide an intimate and comprehensive look into our project. Anyone with interest in our project is encouraged to visit the website in addition to reading this report. The narrative presented here, in turn, contains information not yet available on the website. We will eventually upload this new material, but it is offered now in the interests of providing a full summary of our work as part of our reporting requirements to the NEH.

(Note: The narrative below begins with a short “Initial History,” which technically falls outside of the NEH grant period, but which outlines the conditions that made our application to the NEH and our subsequent project possible.)

Initial History

Locating the Manuscript

Adrian S. Wisnicki first took interest in the manuscript of Livingstone's 1871 Field Diary while researching a book chapter on Victorian travel to Nyangwe, the village in which Livingstone wrote most of the diary. *The Livingstone Catalogue of Documents* (1979) placed the manuscript in the John Murray Archive in London, but further enquiries revealed that the National Library of Scotland (NLS), which now owns the Murray Archive, had only low-quality photocopies of the manuscript made in the 1970s.

The Catalogue also noted that the museum based at Livingstone's childhood home in Blantyre, the Scottish National Memorial to David Livingstone (also known as the David Livingstone Centre [DLC]), had previously owned the manuscript. As a result, Wisnicki next visited the DLC in June 2009 and – thanks to the efforts of Anne Martin, volunteer archivist at the DLC – located the second half of the manuscript, those pages held under DLC shelfmark 297b. The whereabouts of the remaining pages remained a mystery. Wisnicki also discovered that the manuscript was illegible, with only some 15% of Livingstone's text being visible. Livingstone's improvised ink had faded, while the newsprint over which he wrote remained prominent, thereby obscuring the handwritten text. Despite these issues, Wisnicki had a hunch that the text could be recovered.

Contacting the Archimedes Team and Visit to Blantyre

Wisnicki queried L-SHARP, the listserv of the Society for the History of Authorship, Reading, and Publishing, and asked for help in reading the Livingstone's writing. The email caught the attention of Will Noel, Curator of Manuscripts at the Walters Art Museum in Baltimore, Maryland. Noel forwarded Wisnicki's email to the Archimedes Palimpsest spectral imaging team who then contacted Wisnicki. The Archimedes imaging team took interest in the diary because it offered the opportunity to apply spectral imaging and processing techniques developed to study older, parchment-based palimpsests to a more modern, paper-based document. Christopher Lawrence, director of *Livingstone Online*, the main internet resource for Livingstone's writings, encouraged such a collaborative project and offered to publish the results through his site.

As a result, two representatives of the Archimedes imaging team, Program Manager Mike Toth and Data Manager Doug Emery, joined Wisnicki, Debbie Harrison (medical humanities specialist and Wisnicki's colleague at Birkbeck College), and Sharon Messenger (then research assistant at *Livingstone Online*) in visiting the DLC in mid October 2009. The group met with representatives of the DLC, including trustees, staff, and representatives from the National Trust for Scotland (NTS), to discuss the project and view the manuscript. The group took a small sample of the laminate used on the manuscript leaves for assessment at the U.S. Library of Congress and comparison with other spectrally imaged laminated documents. The group also collected some sample spectral images of a few leaves to validate the potential of spectral imaging to reveal Livingstone's text. They collected the images in a darkened room by using a small 5 MegaPixel color camera taped to an overhead projector arm and a handheld light source with UV, red, green, yellow and blue lights.

Funding and the Missing Diary Pages

Initial contact between Wisnicki (residing first in London, then New York City, and now Indiana, Pennsylvania) and Harrison (London), and the Archimedes imaging team (Washington, D.C.; Baltimore, Maryland; Rochester, New York; Maui, Hawaii) resulted in extensive follow-up discussion by telephone, Skype, and email regarding a possible collaboration. The group also decided to apply to the U.S. National Endowment for the Humanities (NEH) for a Digital Humanities Start-Up Grant. Mike Phelps, Executive Director of the Early Manuscripts Electronic Library, offered to have his organization serve as the grantee organization and himself as grant administrator, and the team submitted a formal application to the NEH on 6 October 2009. The team also submitted an application to the British Academy for a Small Research Grant on 20 February 2010.

During late 2009 and early 2010, Anne Martin continued her efforts at the DLC in locating the remaining pages of the 1871 Field Diary. The pages had not been catalogued properly, but Martin's perseverance resulted not only in the rediscovery of the missing pages (those now under DLC shelfmark 297c) but also in the recovery of several pages of the Bambarre Field Diary (1870-71), which she and Wisnicki had not been able to locate during Wisnicki's initial visit to Blantyre in June 2009 (the pages now under 297d and 297e).

Livingstone's Letter from Bambarre

Simultaneously, in late 2009 Elizabeth Upper, a graduate student of Cambridge University, contacted Livingstone Online on behalf of Peter Beard, the American photographer. Beard and his wife Nejma offered to make available for study a previously unpublished Livingstone letter from their personal collection in New York City. By a striking coincidence, Livingstone had composed this letter during the same period as the Bambarre and Nyangwe Field Diaries, using the same improvised techniques.

More fortuitously still, Wisnicki, who was then a research consultant for *Livingstone Online*, had himself just moved to New York City and was residing a mere 8 miles away from the letter. Wisnicki visited the Peter Beard Studio to view the letter and eventually arranged for its transport to the Walters Art Museum, where the letter was spectrally imaged in early 2010 during a separately funded palimpsest imaging project. On 2 July 2010, the team formally announced the start up of The David Livingstone Spectral Imaging Project with the publication of this letter in a multispectral critical edition as *Livingstone's Letter from Bambarre*. That edition then became the prototype and template for published electronic edition of *Livingstone's 1871 Field Diary*.

Project Planning

The U.S. National Endowment for the Humanities (NEH) formally awarded the Livingstone team a Digital Humanities Start-Up Grant on 11 March 2010. The team's grant application set the start date as 1 May 2010. Planning for the project began with the drafting of the grant application, but serious plans could not go forward until this grant announcement.

Setting the Stage

The team decided to travel to Scotland for the spectral imaging of Livingstone's manuscript in mid-June 2010. This travel date necessitated that preparations begin from the moment of the announcement. The trustees of the David Livingstone Centre (DLC) had given the team preliminary permission for the project, but full written permission had now to be secured. A conservator would have to examine the manuscript and prepare it for imaging. The team had to select a site for the spectral imaging that met the technical requirements of the project. Finally, the team also needed to prepare a detailed imaging plan that included a Statement of Work (SOW) agreed on by all stakeholders, conduct a site survey, and secure the support of appropriate local personnel.

After discussion with the DLC staff, the Livingstone team decided to carry out the imaging at a second site. The National Library of Scotland (NLS), being located an hour by car from the DLC, offered the perfect alternative. Wisnicki had previously discussed the project with Alison Metcalfe, Manuscripts Curator at the National Library of Scotland (NLS), and together Wisnicki and Metcalfe now formalized the role of the NLS as a project partner. There were several advantages to this relationship. The library could provide the facilities and personnel needed to adequately support the project, and the library holds the largest number of Livingstone materials in the world. Should the imaging run ahead of schedule, Livingstone materials from the NLS could be spectrally imaged without added cost.

Permission and Conservation

With the location secured, Wisnicki now wrote letters to the DLC trustees and the Livingstone family for permission to transport, spectrally image, and digitally publish the relevant materials from the DLC and related materials at the NLS. Neil Imray Livingstone Wilson and Ian Livingstone proved to be very enthusiastic about the project and kindly granted permission on behalf of, respectively, the Livingstone family and the DLC trustees.

The National Trust for Scotland, in turn, arranged for Helen Creasy, Paper and Photograph Conservator at the Scottish Conservation Studio, to prepare the DLC materials for imaging, an activity covered by the team's NEH grant. Creasy's work included stabilizing documents for handling, repairing all edge tears and tears along central fold lines, reattaching a detached page, and supporting manuscript weaknesses using very light-weight Japanese tissue and wheat starch paste. She also photographed the documents before and after treatment, and secured and packed them for transportation. Kate Kidd, conservator at the NLS, evaluated the related NLS materials and found that they needed only minimal conservation, which the NLS provided pro bono.

Project Planning

Project planning took up the majority of time prior to the team's departure for Scotland. Michael B. Toth, Program Manager for the Livingstone project, supervised this planning with strategic support from Wisnicki, Metcalfe, Robert Jackson (Preservation and Conservation Manager at the NLS), and other team members. Toth's work included developing a detailed imaging plan that outlined 1) an Assessment and Pilot Phase, 2) a Planning Phase, 3) an Imaging and Processing Phase, and 4) a Data Management Phase. Toth broke up each of these phases into discrete tasks, determined how many days would be required for each, and allocated work

accordingly. Toth also prepared a series of documents for team members that foregrounded the relationships between the different tasks.

Alongside this work, Toth explored available imaging options. He circulated documents that detailed imaging schedule and on-site processing possibilities, and that highlighted potential issues. A follow-up imaging draft plan enumerated the specific pages to be imaged, proposed a day-by-day imaging schedule, and sketched a data delivery schedule. Toth also used email, phone calls, and teleconferences to coordinate activities between NLS staff, team members traveling from the U.S. to Scotland (Wisnicki, Bill Christens-Barry, Roger L. Easton Jr., and Ken Boydston), and team members that would provide support from the U.S. (Keith Knox, Doug Emery).

These activities culminated in a formal Statement of Work (SOW) that set out:

1. Project scope
2. Program Management
3. Imaging Tasks
4. Metadata Preparation
5. Deliverable Items
6. Key Personnel
7. Permissions
8. Institutional Requirements
9. Schedule

Toth developed this document in close collaboration with Wisnicki and representatives of the NLS. The drafting process served to introduce NLS staff to the rubrics of multispectral imaging and underscored key requirements of the Livingstone team in Scotland, including the need to recruit and train local personnel for basic operation of the imaging system.

Just prior to departure, Toth developed a plan for transporting equipment to Scotland, and created a site survey checklist for team members who intended to visit the NLS in advance of the imaging sessions. In addition, days before the team left, the British Academy announced that it had awarded the team a Small Research Grant, which provided both for an enhanced site survey and helped defray other travel costs.

Spectral Imaging in Scotland

Spectral imaging, when used for the study of cultural objects, involves illuminating an object with successive wavelengths of light – starting with ultraviolet, working through the visible spectrum, and concluding with infrared – then digitally photographing the resulting illuminations. The produced images all have exactly the same pixel dimensions, and are spatially registered, the content being equivalent at each pixel location in each image. Later, imaging scientists process this data in order to enhance select features of the cultural object.

Imaging Set-Up

The Livingstone team spectrally imaged the 1871 Field Diary in the Reprographics Studio at the National Library of Scotland (NLS). The NLS could only allocate about half of the Studio to the team due to the need to support other ongoing activities. As a result, the team created a dark

room by purchasing window curtain "blackout" lining at a local store and then hanging this curtain over the opening between the two halves of the Reprographics Studio, an expedient that worked surprisingly well. The NLS also provided the copy stand upon which all Livingstone folia were placed for imaging, tripods for the lighting system, a computer monitor for the camera system, and two workstations for the individuals operating the camera system and data logger.

The Livingstone team transported the EurekaVision™ spectral imaging system from the U.S. and set up the system during the first two days of the imaging sessions. The EurekaVision™ system, a state-of-the-art image capture system, maximizes the information recorded with minimum impact on the historical documents. MegaVision's Photoshoot™, the software that powers the system, is designed to ease user tasks such as image sequence setup, imaging parameter entry, focus and image inspection, collection and organization of metadata, and image conversion and storage.

The components transported by the team to Edinburgh included:

- 1) monochrome MegaVision E6 39 megapixel camera back (7216 X 5412 pixels; 16-bit data with approximately 12 bits of dynamic range) mounted in a technical view camera with a 60mm UV-VIS-IR lens and a color filter wheel installed for UV fluorescence studies.
- 2) light-emitting diode (LED) illumination panels which were placed on tripods on either side of the copy stand in symmetric downward-looking positions angled approximately 45° on either side. The team also used diffusers to create uniform and nondirectional light fields. Raking illumination was provided in two spectral bands from either side of the manuscript.
- 3) modified desktop computer that controlled the imaging system using MegaVision's Photoshoot™ 4.0 software. This software orchestrated the operation of both camera and lighting through FireWire and USB connections, respectively.

Each LED panel contains seven banks of LEDs that emit in the ultraviolet (1 wavelength) and visible regions (6 wavelengths) of the spectrum and five additional clusters of LEDs that emit in the infrared region (5 wavelengths). The geometry of the LED light panels is designed to provide maximum uniformity of the illumination at the surface of a leaf being imaged. A primary advantage of the system is that LEDs do not generate heat that can damage fragile pages. In addition, illumination from a low "raking" angle enhances the visibility of surface height variation, yielding images in which impressions or surface relief features are enhanced.

The EurekaVision™ system illuminated each Livingstone folio with twelve bands of wavelengths of light from the ultraviolet (UV) through the visible and the infrared (IR):

Band = Wavelength in nanometers	
01 = 365 (UV)	07 = 638
02 = 450	08 = 700 (near IR)
03 = 465	09 = 735 (near IR)
04 = 505	10 = 780 (near IR)
05 = 535	11 = 850 (near IR)
06 = 592	12 = 940 (near IR)

The monochrome camera automatically photographed the folio under each illumination, with the raw image data stored on an external hard drive attached to the desktop computer. In addition,

the team used four raking lights (lights that illuminate the folia at an oblique angle and so highlight page topography) mounted within separate panels and on separate tripods when imaging folia that had not been laminated, as follows:

Band = Wavelength in nanometers
13 = 940RR (IR raking right)
14 = 465RR (blue raking right)
15 = 940RL (IR raking left)
16 = 465RL (blue raking left)

The team chose to use a monochrome camera, without color or infrared filters, because doing so allows: 1) lower light levels for illumination, 2) no interpolation or preprocessing of the filtered image, minimizing collection artifacts, and 3) unfiltered light from all spectral bands to reach the camera sensor. Such a camera yields very pure, high-resolution, registered images of each spectral band and facilitates processing not only for text enhancement, but also for very accurate color reproduction.

Data Logging, Collection, and Copying

The camera operator and the data logger collaborated in running the EurekaVision™ system, while a representative of the NLS or the NTS handled the primary documents and set and flipped them on the copy stand. A variety of locally-recruited personnel took part in the camera operation and data logging, including Anne Martin (DLC), Karen Carruthers (DLC), Suzanne Lamb (NTS), Alison Metcalfe (NLS), and Kate Simpson (Edinburgh Napier University). Several Livingstone team members also actively participated. The process required constant rotation of personnel due to the long hours, continuous concentration required, and complexity of the data to be logged.

To ensure the team captured accurate metadata about the objects and images, Data Manager Emery developed the Multispectral The Multispectral Imaging Metadata Machine, or MSIMM (pronounced "Miss M."), which powered data logging. As each document came up for imaging, the data logger located the document in the MSIMM database and read off the file name to the system operator who entered it into MegaVision's Photoshoot™. The data logger, in turn, noted any unusual features of the document or exceptional imaging circumstances (such as a reshoot due to previous interruptions) in the log. Once data had been entered, all personnel put on UV protective glasses, turned off the room lights, and the capture of the image set began. Each capture lasted about two minutes, with times slightly extended when raking lights were used. During capture no one could pass through the dark room because the data could be compromised and because individuals without appropriate eye protection could be injured by UV light.

The desktop computer powering the imaging system also collected the raw image data to an external hard drive. For each image, the system produced an image set of either twelve registered images or sixteen if the raking lights were used. Periodically, team members swapped out the hard drive containing the raw data and took it away for copying, a task which constituted a full-time job in itself. Team members copied the raw data to other external hard drives brought by the team and transferred files externally via FTP overnight to a designated site. This distribution strategy helped prevent the loss of data and made the data available to scientists onsite (Easton, Christens-Barry) and overseas in Hawaii (Knox) for validation,

assessment, and initial processing. It also allowed Emery to review the data and metadata for quality and provide updates to the metadata records and software. The distribution also allowed the David Livingstone Spectral Imaging Project to operate twenty-four hours a day during this period.

Personnel and Activities

The Livingstone team spent a week and a half in Edinburgh (18 June, then 24 June to 3 July 2010). Team members arrived and took part in activities according to the following schedule:

Date	Activity	File Prefix of Folia Imaged	Personnel	External Visitors
18 June, Fri	site survey		Christens-Barry, Easton (en route to other work in Europe)	
24 June, Thur	site survey / initial set-up		Wisnicki	Suzanne Lamb (NTS)
25 June, Fri	complete set up / initial imaging	NLS10701, NLS10707, NLS10768, DLC1120b	Wisnicki, Toth, Boydston, Simpson	
26 June, Sat	imaging	DLC297c, DLC297b, DLC297e	Wisnicki, Toth, Boydston, Easton, Simpson	
27 June, Sun				
28 June, Mon	imaging	NLS10703, DLC297d	Wisnicki, Toth, Boydston, Easton, Christens-Barry, Simpson	Anne Martin (DLC)
29 June, Tue	imaging	NLS10703, DLC297a	Wisnicki, Toth, Boydston, Easton, Christens-Barry, Simpson	Karen Carruthers (DLC), Ian Riches (NTS), John Sinclair (NTS), Suzanne Lamb (NTS)
30 June, Wed	imaging	DLC297a, NLS10703 [NLS72.1.1]	Toth, Boydston, Easton, Christens-Barry, Simpson	
1 July, Thur	imaging	DLC297e, DLC1120b, NLS10701, NLS10768, DLC297c, [NLS42237]	Wisnicki, Harrison, Toth, Boydston, Easton, Christens-Barry, Simpson	Karen Carruthers (DLC)
2 July, Fri	imaging	[NLS43325], [NLS43327], [NLS43408]	Wisnicki, Harrison, Toth, Easton, Christens-Barry, Simpson	
3 July, Sat	pack up equipment		Toth, Easton, Christens-Barry,	

Note: Folia marked with square brackets are non-Livingstone manuscripts imaged at request of the NLS. In addition, the team received regular assistance from NLS staff, including Alison Metcalfe, Rab Jackson, George Morrison, Kate Kidd, and Sally Todd.

During the sessions, Wisnicki also took a day off (30 June) to travel up to Aberdeen where he met with historian Roy Bridges. Professor Bridges's pioneering studies of the manuscripts of Victorian explorers of Africa – Livingstone in particular – had provided one of the key inspirations for Wisnicki to take forward his work on the diary. The visit allowed Wisnicki to meet Professor Bridges and describe the objectives of the spectral imaging project. Professor Bridges, in turn, furnished Wisnicki with a number of articles and other items – many of them unpublished – that would be useful to Wisnicki's research on the 1871 Field Diary.

Imaging Schedule and Objectives

In planning for the spectral imaging sessions, the team allowed for two different scenarios. Imaging the folia with the file prefixes DLC297b and DLC297c, the core of the 1871 Field Diary, would take up the whole time in the worst-case scenario. Livingstone had used his improvised red ink on these folia. The newspaper pages over which he wrote had deteriorated over time. The pages had been laminated with a heat-set document repair tissue, a factor that compromised legibility and had the potential to impede spectral imaging and processing. Finally, the average page size (10 x 12 inches) suggested that each would have to be imaged in two segments and imaging time would be doubled if the imaging conditions at the NLS were not ideal.

None of these issues would emerge in the best-case scenario. Imaging of the DLC297b and DLC297c folia would proceed smoothly, without any compromise in quality, and the team would have time to image at least a portion of the additional manuscript pages. There was reason to hope for this scenario. The team had collected a small sample of the laminate on DLC297b and DLC297c in October 2009. Subsequent comparative analysis by Fenella France, Research Chemist at the U.S. Library of Congress (LoC), using another sample at the LoC with a known spectral response helped the team understand some focus issues associated with imaging laminated documents. In addition, Easton had processed some of the low-resolution, unregistered spectral images collected in October 2009, and the results were promising. Finally, in Scotland the team could also draw on the experience of working with the *Letter from Bambarre*.

As a result, the team balanced the schedule and cost risks and set their sights on the best-case scenario, a highly desirable outcome given the effort and expense involved in coordinating schedules, securing permissions, arranging facilities, and bringing equipment and personnel to Scotland. As a test run, the team spent most of the first imaging session (24 June) on letters and diary pages composed with the same materials as the *Letter from Bambarre* or with the same ink as the 1871 Field Diary. The experiment proved a full success, with no issues coming into play, so on the second day, a Saturday, the team moved to the DLC297b and DLC297c folia. Again, none of the anticipated issues arose, and the team not only completed the entire run of these folia, but also those of DLC297e. This development put the team five days ahead of schedule.

The team moved to additional DLC and NLS pages in the following days. By capturing these images the team ultimately doubled its anticipated results and laid the groundwork for the next phase of the project at no added cost. In fact, the team ran so far ahead of schedule that they

concluded the imaging sessions by spectrally imaging a number of sample manuscript folia at the request of the NLS. These included two folia from a Gaelic 1467 manuscript by Dubhghall Albanach mac mhic Cathail (file prefix NLS72.1.1), a few letters from Lord Byron (NLS43325, NLS43327, and NLS43408), and the entire text of Sir John Franklin's 1821 Field Diary (NLS42237).

The success and scope of this spectral imaging effort, therefore, which depended on a combination of foresight, preparation, team discipline, risk management, and luck, represents one of the major accomplishments of the David Livingstone Spectral Imaging Project.

Spectral Image Processing

The spectral imaging of the 1871 Field Diary and associated documents produced raw image sets of 202 Livingstone folia in total, not including extraneous image sets and sets of documents imaged for the NLS. 50 of these image sets (those of laminated folia) each contained 12 registered, spectral image "digital negative" files (DNGs), while the remaining 152 image sets contained 16 DNGs due to the inclusion of "raking light" images. In other words, the spectral imaging of Livingstone's diary results in the creation of 3,032 "raw" images files totaling, roughly, 750 GB of data. This data required processing by the team's imaging scientists in order to make Livingstone's handwritten text accessible to specialists and the public-at-large.

Spectral image processing uses tailored mathematical algorithms in order to manipulate and enhance raw spectral image data. In the case of Livingstone's manuscripts, such processing relies on the fact that different ink types on a given page (for instance, Livingstone's ink, the ink of the newsprint, etc.) behave differently under different bands of wavelengths of light. Imaging scientists use this differentiated behavior to create processed images (renderings of combinations of bands) that distinguish among what may be otherwise very subtle differences in color. The processing of the Livingstone data began while the team was still in Scotland in June 2010 and lasted well into the spring of 2011.

Principal Component Analysis (PCA)

Onsite processing in Scotland by Easton and Christens-Barry relied primarily on applying principal component analysis (PCA) to the raw image sets. In addition, Easton and his student Caroline Houston continued to experiment with this technique after the initial imaging phase. The PCA technique uses combinations of an original set of images to construct an equivalent set of images ordered by statistical variance. The first principal component is a combination of the original images with the largest variance; the second principal component is the combination of the original with the next largest variance orthogonal to the first, etc. Images from initial PC bands ("high order" bands) correspond to the smallest data variances. If the images contain objects that differ in color, they may be distinguished ("segmented") in the set of principal components.

Once the PC images are produced, the scientists examine the images to identify those that show different inks and insert these images into the red, green, and blue channels (RGB) of a "pseudocolor" (false color) image. If the handwritten ink appears as "light" in one of the PC images and "dark" in another, then the corresponding pixels may exhibit a color tone in the pseudocolor image that allows easier differentiation between the handwritten and printed texts. If necessary, the scientists further manipulate the pseudocolor image by using appropriate

software to rotate the hue angle of the pseudocolor image to generate new combinations of the principal components. However, the process is not conducive to automation because of the manual steps involved and so is most feasible for the study of exceptionally illegible portions of text.

Spectral Ratio and Pseudocolor Rendering

Knox, who remained in Hawaii during the onsite imaging phase, supplemented both initial and follow-up PCA processing with techniques previously developed and/or refined for the *Letter from Bambarre*. In subsequent months, after the team and the data returned from Scotland, Knox also developed two additional techniques that proved instrumental to deciphering Livingstone's writing.

The first of these additional techniques lent itself to automation and so could be applied across all the Livingstone data sets without additional cost or labor. In December 2010, Knox discovered that although Livingstone's writing faded as the wavelengths increased (and completely disappeared at the 940 nm wavelength), the printed text remained fairly constant across the spectrum. Knox therefore calculated the numerical ratio of the 450 nm, 592 nm, and 850 nm images relative to the 940 nm separation and put the resulting three images into, respectively, the red, green, and blue channels of a pseudocolor image. This technique effectively suppressed the printed text and made Livingstone's handwriting very visible.

A second technique, which could be partly automated, focused on minimizing ink bleedthrough. This technique involved rendering pseudocolor images using combinations of raw spectral images. In this case, Knox selected two images of the recto side of a given leaf (the 505 nm and 780 nm illuminations), and one image of the verso (505 nm) that he flipped horizontally. He performed a spatially local normalization of contrast and brightness on each image, then inserted these three images into, respectively, the red, green, and blue channels of a pseudocolor image. The resulting image displayed the recto text in cyan-blue and the verso text in green-yellow, a combination that significantly enhanced the legibility of the recto text.

Processing Objectives and Results

The Livingstone team developed a list of leaves for processing after the preliminary processing in June 2010, which established the viability of recovering Livingstone's text. This list prioritized the most challenging images (those under the file prefixes DLC297b and DLC297c), while suggesting only color rendering for the most legible folia, the latter of which would be produced using a text file script with an executable program. The subsequent months of processing entailed a high degree of collaboration between imaging scientists and Wisnicki, who assessed whether processing results met scholarly needs and who suggested further possibilities for experimentation.

The scholar-scientist discussions also resulted in comparative analysis of processing techniques and the development of additional PCA and pseudocolor processing strategies, some of which could be automated. These additional techniques included a pseudocolor method that suppresses all written and printed text, and that highlights paper topography (raking). Furthermore, during this period, Christens-Barry developed the "Equipoise Toolbox" palette for ImageJ, an open-source image processing software package. This palette allowed

Wisnicki and other scholars to fine-tune the spectral images batch produced by the imaging scientists.

Ultimately, the work of the scientists resulted in the creation of a variety of spectral image processing techniques to recover the text of Livingstone's 1871 Field Diary. The imaging scientists applied nearly all of these techniques to the diary and, where possible, used automation to extend their work to the other Livingstone manuscript leaves captured in Scotland.

Data Management

Preliminary spectral imaging of Livingstone's diary in Scotland and follow-up spectral image processing generated a significant amount of data and metadata. This data required far-sighted and detail-oriented data management to ensure efficient capture, production, and organization for long-term viability. The team's data manager, Doug Emery, directed this process from beginning to end with assistance from members of the Livingstone team.

The team summarized data management objectives in their original NEH grant application: "The Nyangwe field diary project will provide a complete package of images with documentation and full metadata. The resulting archive data set will be based on the archive and metadata model used for the Archimedes Palimpsest. The product will be a completely self-documenting and autonomous data set. [...] This will be a full digital archive of images that meets library and archival standards, as we have produced for previous projects."

Preliminary Data Management

The team followed a series of intermediate steps to meet the data objectives, a process that spanned nearly the whole 18-month NEH and British Academy grant periods. The process began prior to imaging in Scotland with a series of discussions by email and teleconference in which the team set out the details of the data archive deliverable, began to define XML transcription guidelines, and assessed metadata needs of key stakeholders. The team also explored the implications of various hosting and publication options.

During this period, Emery began planning for the collection of appropriate metadata. He created a spreadsheet of the folia to be imaged that included location shelfmark (DLC or NLS), details of Livingstone's handwritten "overtxts" and pre-printed "undertxts," and shots required (to identify folia to be imaged in segments). He reconfigured his online logging application to meet project needs and used the application to create Livingstone imaging projects and associated shot sequences. Finally, he instructed the imaging scientists in collecting image setup data. From Baltimore, Emery continued to support daily metadata collection while the team imaged in Scotland.

"Data Scrubbing"

Once imaging ended, the team moved to a lengthy period of data assessment and correction. In late July 2011, Emery produced an initial evaluation of the Livingstone data, then based on this evaluation he, Toth, and Wisnicki sought to refine the existing data management plan. In the coming months, Toth also outlined the overall path forward in a series of emails to the team,

ultimately developing a phased approach based on prioritized goals, capability needs, and funding available for each phase.

The duration of the assessment and correction period had partly to do with the file-naming scheme created by the team. The scheme took the following form:

Segment	Referent	Example
First	institution initials plus shelfmark	DLC297b
Second	Livingstone's folio number(s) (in Arabic numerals) or, if not provided, begin with 001 (for both recto and verso), then 002 (recto and verso), etc.	149-146
Third	institution folio number or, if not provided, begin with 001 (for both recto and verso), then 002 (recto and verso), etc. plus "r" or "v" designation	012r
Fourth	"0" if only one shot required; "0," "1," "2," etc. if folio imaged in parts	0
Fifth	shot sequence letter "A," "B," "C," etc.	A
Suffix	image or document type	dng

This scheme produced a rather lengthy name for each image file, e.g., DLC297b_149-146_012r_0_A.dng. The advantage of the scheme lay in how much information it recorded. The disadvantage of the scheme, which the team realized only in hindsight, inhered in its complexity. The scheme allowed for a wide margin of error, especially as the hours and days in the darkened imaging room lengthened. Moreover, the need for preliminary processing during the imaging phase and beyond resulted in the exponential propagation of incorrect file names.

After Emery's evaluation, Knox and Wisnicki collaborated in reviewing and correcting the raw data and Knox's processed data. Using Wisnicki's list of file and folder corrections and additional input, Knox "scrubbed" the data in a series of steps:

1. identify and correct duplicates, misnamed files, and excess files;
2. create command files to convert the data according to Wisnicki's list;
3. produce PowerPoint summary of data set.

The process – which required many, many hours due to the complexity of the files names – lasted from August to December 2010, significantly longer than anticipated.

Creating the Data Archive

The need for extensive data correction pushed the spectral image processing phase to the spring of 2011. This development, in turn, delayed Wisnicki and Simpson from beginning XML transcription until late February 2011. As a result, the team continued to produce significant new primary data (images and transcriptions) well into June 2011 and so prevented final work on the archive until mid June.

In the NEH grant application, the team had described this next phase as follows: "After imaging and processing is completed, the imaging logs will be collated with other required metadata to generate complete metadata records for raw and processed images, and to assemble the final

data archive." To realize these objectives, Emery needed to complete a complex series of discrete tasks. These covered preparing the raw data, collecting the new data produced by the team, assembling and refining the database, collecting and building the metadata, and loading and packaging the data.

During the final months of the data management phase (June to September 2011) Emery worked in close collaboration with Wisnicki and the imaging scientists to finalize the archive, refine details of the archive structure, collect all required metadata, and identify missing processed images. In his efforts, Emery prioritized the 1871 Field Diary data but, where possible, included NLS data in bulk management tasks.

Emery allocated much of his time to the labor intensive task of correcting the database so that it would work with the corrected file names produced by Knox and so that he, Emery, could produce accurate metadata. Emery also set up a server with the metadata database allowing Wisnicki to verify the data and add new information as needed (including image rotation data). Finally, Emery and Wisnicki carefully corrected the names of processed files from Christens-Barry, Easton, and Houston. Emery completed the data archive on 27 September 2011, made a backup, then shipped the hard drive to Wisnicki, who received it 29 September, made a copy, and shipped it on to Stephen Davison, Head of the UCLA Digital Library Program.

Restoring the Text

Data Hosting

The size of the Livingstone data archive necessitated hosting by an institution that could provide robust, long-term data storage and curation. The NEH grant application stated that the archive would "be hosted by *Livingstone Online*, while backup data hosting will be facilitated by The Early Manuscripts Electronic Library."

To meet this requirement, Wisnicki in collaboration with Michael Phelps (Executive Director of EMEL), Todd Grapone (Associate University Librarian for Digital Initiatives and Information Technology at UCLA), and Stephen Davison (Head of the UCLA Digital Library Program) arranged for UCLA both to host the data and seamlessly integrate it into *Livingstone Online*. Subsequent funding complications for *Livingstone Online*, however, necessitated that the integration be put off to a later date, and the team devised an alternative publication strategy: hosting by the UCLA Digital Library Program and joint publication by the Library and *Livingstone Online*.

Creating a Publication Template and XML Encoding

In July 2010, the Livingstone team published the beta version of *Letter from Bambarre* through EMEL. This represented an interim solution necessitated by funding and resource constraints. The team transferred the *Letter* to the UCLA Digital Library, once the partnership with UCLA had been established in August 2010. Kristin Jensen of Between the Lines Editing, Ireland, provided pro-bono editorial work, then Wisnicki in collaboration with Sarina Sinick, a student at UCLA, began to refine and develop the electronic edition of the Letter. They completed the edition in May 2011 and formally republished the *Letter*, with announcements sent out to academic sites. To streamline efforts, the team decided to use the new edition of the *Letter* as the publication template for the 1871 Field Diary.

Simultaneously, Wisnicki in collaboration with Kate Simpson, a research assistant recruited from the Edinburgh Napier University, began to transcribe and encode the 1871 Field Diary in XML. The transcription and encoding process got underway in February 2011 as the imaging scientists systematically began to produce the processed spectral images. Wisnicki's prior XML experience was limited to encoding the exceptionally challenging *Letter from Bambarre* in TEI P4 using the *Livingstone Online* tagging guidelines. However, the Livingstone team decided to encode the diary in TEI P5.

As a result, Lisa McAulay, the Librarian for Digital Collection Development at UCLA, now updated the *Letter*, created an encoding template for Wisnicki, and provided Wisnicki with strategic encoding support. Later, James Cummings, Manager of InfoDev (Research Support and Data Solutions) at the University of Oxford, also assisted the team in addressing the most difficult encoding issues. Thanks to this assistance, Wisnicki quickly developed TEI P5 proficiency and, in turn, trained Simpson who had no prior tagging experience. Wisnicki also summarized all encoding decisions in a detailed XML TEI P5 Encoding Practices document.

The decision to encode each folio of Livingstone's diary separately represented one of the Livingstone team's most important encoding decisions. With some exceptions, each folio of Livingstone's diary contains two diary pages, one on the left-hand side, one on the right-hand side. Adjacent pages are almost never continuous because Livingstone stacked, then folded the leaves of the diary to make two copy-books (now disassembled). As a result, the team chose to represent the physical artifact (the manuscript as it is) rather than the semantic artifact (what Livingstone "intended") in order to reflect the current state of the diary and to coordinate with the structure of the data archive, where the images for each folio would reside in a separate directory.

Transcription Outcomes

Livingstone's words had taken an exceptionally long detour in their travels, but now had almost reached their destination. Wisnicki and Simpson completed the transcription and encoding of the diary in early August 2011. They succeeded in transcribing – and so making accessible – 99% of the diary's original text for the first time since Livingstone wrote the document 140 years ago. Issues such as fading, blotting, bad handwriting, or missing pieces of the manuscript prevented the remaining 1% from being deciphered. The majority of the issues fell outside the remit of the Livingstone project, which focused on using spectral image processing to separate Livingstone's words from the printed texts over which he wrote. In other words, the team had a success rate of nearly 100%, an outcome that far exceeded even the most optimistic team predictions and that rendered unnecessary a number of alternative imaging and processing strategies outlined in the original NEH grant application.

To complete the transcription and encoding process, Wisnicki collaborated with research assistant Heather F. Ball to produce an XML transcription of the corresponding portion of the *Last Journals* (1874). This transcription refined and corrected the rough transcription available from Project Gutenberg. Wisnicki, Ball, and A.J. Schmitz (Wisnicki's graduate assistant from Indiana University of Pennsylvania) then corrected and revised the *Last Journals* transcription to produce an encoded version of the relevant portion of Livingstone's handwritten 1872 Journal. Schmitz also used macros created for ImageJ by Christens-Barry to produce line-by-line mappings of the 1871 Field Diary.

Thanks to these final efforts, readers of the 1871 Field Diary would be able to study the original words of the diary alongside the revised 1872 Journal and the 1874 published text. They would be able to survey firsthand the vast distance that separated the original and published versions of the diary and, as a result, trace the extent to which subsequent revisions by Livingstone, Waller, and others had transformed the original historical record. The mappings, when incorporated into the XML transcriptions, would also help readers and support software tools to relate passages on the images to the transcriptions and vice versa.

The Electronic Edition

Wisnicki collaborated with the staff of the UCLA Digital Library to develop the final format of the electronic edition. This format drew on the *Letter from Bambarre* template, and so used a similar layout and included many of the critical elements incorporated into the template. However, the team also decided to include a number of new features. Developing these features, however, proved quite challenging, and it was only by sheer force of will that the UCLA Digital Library staff finished the site in collaboration with Wisnicki during the last month of the project (October 2011).

The team designed the new features to showcase the scholarly and scientific accomplishments of the Livingstone team. Most importantly, the present electronic edition links to and so provides the gateway to the Livingstone spectral image archive created by Emery. This archive allows users to download and study all the XML files and raw and processed images (as 8-bit TIFF files with full metadata) produced by the project. As a result, the archive provides access to uncompressed images and critically marked-up texts of, respectively, all the JPEGs and transcriptions published through the electronic edition.

The electronic edition also contains a selection of custom designed web pages:

Images and Transcriptions – Enables users to examine processed spectral ratio image versions of individual pages of the 1871 Field Diary alongside transcriptions. The embedded viewer allows users to view, rotate, and enlarge the cropped spectral ratio images.

Three Versions of the Text – Enables users to scroll simultaneously through and search by keyword and date the three versions of Livingstone's text (1871, 1872, 1874).

Search Page – Enables users to search through and sort the full text of the 1871 Field Diary by keyword and significant XML-tagged content

Finally, the electronic edition includes a Project History & Archive section which offers a detailed and, at times, intimate look into the inner workings of The Livingstone Spectral Imaging Project. Users can now not only overview the different phases by which the project evolved, but also download a representative selection of raw working documents produced in the course of the team's efforts.

Analysis to Dissemination

Preliminary Data Analysis

The spectral imaging and transcription of Livingstone's diary produced a treasure trove of data. Alongside many other tasks, Wisnicki worked with team members to develop a preliminary analysis of this data during the final phase of the project. This endeavor embraced a number of discrete activities.

First, Wisnicki produced a detailed history of the diary that tracked the manuscript from the nineteenth century to the present day. Anne Martin (DLC) and Alison Metcalfe (NLS) supplied a number of crucial, internal documents to support the research. These documents coupled with materials previously assembled enabled Wisnicki to track – for the first time – the complex journey of the diary that ultimately resulted in the document becoming the first significant nineteenth-century British manuscript to be enhanced with multispectral image processing.

Wisnicki also undertook a careful examination of Livingstone's methods for composing and structuring the manuscript. This examination built on the XML encoding of the manuscript by Wisnicki and Simpson, an endeavor that drew attention to and marked up a wide range of unique textual and material manuscript features. Wisnicki identified the practices Livingstone employed on a day-to-day basis in writing up his experiences and catalogued Livingstone's strategies for organizing entries in the two copy-books that make up the key portion of the diary.

Most importantly, Wisnicki turned his attention to Livingstone's inks. As far back as December 2009, Wisnicki had suggested to Gustavo Fermin (the assistant of Peter Beard, owner of the *Letter from Bambarre*) that Livingstone – in recoding the Nyangwe massacre – had, apparently, switched from the improvised ink he used to compose most of the 1871 field diary to what may have been his last supply of iron gall ink. This suggested that Livingstone had grasped the significance of the events unfolding before him and silently decided that it was worth drawing on his dwindling ink stock to produce a permanent record.

Fenella France (U.S. Library of Congress) advised Wisnicki on the development of new techniques to identify and characterize inks and colorants, while Easton applied these techniques to generate the reflectance spectra for a sample of pages from the diary. The resulting graphs, which Easton collected in a series of PowerPoints, supported through scientific data what Wisnicki had previously deduced based on visual study of the processed images (especially the two paragraphs on page 297b/146).

During this phase, Harrison carried out detailed comparative analysis of the 1871, 1872, and 1874 versions of the manuscript. This work would become the basis of both future research and the press campaign (see below), while Simpson heroically assisted Wisnicki in completing numerous tasks related to the diary's critical apparatus. Wisnicki also carried out further analysis of the three texts to develop the Livingstone in 1871 section, which overviews some of the key new information revealed by the 1871 Field Diary. In addition, Simpson consulted with Ulrike Al-Khamis, a specialist in Arab/Islamic Art and Culture at the University of Edinburgh, and Paul Dundas, a Sanskrit specialist also at Edinburgh, to discuss a number of questions related to the Arab traders with whom Livingstone had travelled and to explore the issue of dating in Livingstone's diary.

Dissemination

The Livingstone team decided to release full project results in beta form on 1 November 2011, a propitious date given that it translated to 1/11/11 (US) or 11/1/11 (UK). The team would mark the release with a series of panel presentations in the UK. The release would coincide with the 140th anniversary of the Livingstone-Stanley meeting. Both Livingstone and Stanley had lost track of the date while travelling, and the exact date continues to be a point of debate among scholars, as noted elsewhere in this edition. The initial date selected therefore represented a compromise between Livingstone's original date of 28 October 1871 (in the 1872 Journal) and Stanley's of 3 November 1871 (in a despatch to the *New York Herald*).

The Livingstone team's dissemination strategy focused on both general and academic audiences. The publication of *Letter from Bambarre* had received international print and broadcast coverage, a development that underscored continuing global interest in Livingstone. In seeking to gain this interest, Harrison drew attention to the project's academic and scientific dimensions in developing the press campaign for the *Letter*. She directed the team in drafting an appealing and dramatic press release with a strong public interest theme. She also sought to accommodate the complexity of the project and to acknowledge the broad range of collaborating individuals and institutions.

The press pack for the *Letter* provided a single press release (aimed at the national UK press), a selection of vivid images, and briefing notes on key individuals, contributing institutions, and the science behind the project. This approach delivered a powerful story that focused on the human interest aspects of Livingstone's ordeals, while simultaneously providing sufficient biographical and technical information to satisfy the needs of the specialist press. The *Letter* press pack appeared on a dedicated page on the Birkbeck website. The team decided to follow a similar strategy for the publication of the 1871 Field Diary, although now the press campaign would have three centers, Birkbeck, the NLS, and UCLA, the co-publisher of the diary.

The October 2011 press campaign represented the culmination of a series of prior conference presentations and public lectures by project team members. The team delivered these presentations to both academic and specialist audiences. The presentations included a "lightning round" presentation (during which presenters received two minutes and were allowed three slides to describe their project) and an invited talk on publicizing the project, both of which Wisnicki delivered at the 2010 NEH Project Directors Meeting in Washington, D.C., on 28 September 2010. Alongside these presentations, the team also distributed an announcement to relevant academic outlets to mark the publication of the revised edition of the *Letter* in May 2011.

Release of Project Results and the UK Tour

As planned, between 29 October 2011 and 8 November 2011, select members of the Livingstone team traveled to the UK to meet with stakeholders and interested scholars and to present on the results of the eighteen-month project. Although timed to coincide with the end of the NEH grant period, all expenses for this trip were funded by the grant from the British Academy.

Meetings with UK stakeholders and scholars had three primary objectives. First, team members shared project results with stakeholders. Second, the team solicited feedback on the two digital resources developed by the project. This feedback will be incorporated into the revised versions

of these resources, which represent a new scholarly activity and which will be published after the NEH grant period, as detailed below. Finally, the team also used the meetings to discuss potential future collaborations between team members, other scholars, and stakeholders. Some of the collaborations grow directly out of the Livingstone project, others are indirectly related to it. In addition, a meeting in Oxford with James Cummings and Sebastian Rahtz of the Information and Support Group, Oxford University Computing Services, created the opportunity to discuss the Livingstone team's TEI P5 encoding strategies.

Project presentations were delivered five times over six days in four cities. One of these presentations was a press conference at the National Library of Scotland coinciding with the launch of the project sites on 1 November 2011. Another presentation introduced conservation staff at the Bodleian Library, University of Oxford, to the technology and digital preservation methods used by the team. The additional three presentations were free public lectures at the National Library of Scotland, the David Livingstone Centre, and Birkbeck, University of London. The team gave the presentations as panel lectures in which team members representing scholarship, science, technology and conservation, outreach, and postgraduate research described their roles on the project.

The gathering of select team members (Wisnicki, Knox, Harrison, Toth, Simpson) and the development of the joint presentations solidified the project accomplishments both for team members and for stakeholders. The presentations and an effective press campaign also resulted in an overwhelming response from press around the world, including coverage in print, digital, and broadcast media. This coverage ranged from full-length articles in leading outlets such as *The New York Times* and *The Washington Post* to a range of tabloids, a point that testifies to the widespread interest that the project generated among a variety of audiences. The coverage also spurred traffic to the project site, which soared from about 30 hits a week prior to the UK tour, to about 3700 visitors during the week of the tour and that following, to, currently (late Jan. 2012) about 200 visitors per week. By the last presentation, the team felt that they had decisively conveyed the significance of being the first people ever to restore and read Livingstone's diary since the nineteenth century.

Lessons Learned and Future Projects

Challenges

The Livingstone team carried out its work despite encountering a number of significant challenges. The team mitigated some of these challenges; other challenges delayed or compromised parts of the overall production schedule, but the team still delivered the final product within the NEH grant period. The principal challenges related to project funding, communication, and file naming.

1. Project Funding

The NEH grant brought the project to life and enabled it to accomplish its proposed goals of spectrally imaging and processing Livingstone's diary. The team knew this project posed risks as proposed, especially with more complex tasks that might be uncompensated. The British Academy grant helped support the imaging effort in Scotland (June-July 2010) as well as the follow up visit (October-November 2011) to promote the project, share results with stakeholders, and receive feedback on the final product. However, the team proved unsuccessful in supplementing these funds during the NEH and British Academy grant periods to support

additional work required. This outcome combined with an unflagging team ethic of delivering, as one member put it, "a BMW project on VW prices," resulted in every funded project member providing significant work for the project out of scope. Unfunded team members, in turn, uniformly assisted on a pro bono basis.

That said, everyone committed to the project or offered to contribute their time and talents – whatever the opportunity cost – foremost from a desire to support a worthwhile endeavor: the restoration of a key manuscript from a visionary explorer whose abolitionist ideals and progressive ideas on the intellectual capabilities of Africans often far surpassed those of his contemporaries. In retrospect, however, it became clear that the team should have developed the project in two, separately-funded phases, the first focusing on the creation of the data archive, the second on the critical edition of the diary. In particular, additional funding for the spectral imaging stage would have allowed for a higher level of programmatic maturity, including better attention to data organization and data copying from the moment of capture.

2. Communication

The first phase of The David Livingstone Spectral Imaging Project brought together individuals residing across the UK and U.S., working in a variety of discrete fields, and affiliated with very diverse institutions. Team members and institutional representatives rarely met in person due to funding limitations, and most involved in the project spoke very different professional languages, a point that could create miscommunication despite the best intentions of everyone involved. Coordinating project stages and activities also proved challenging, especially given the limited time project personnel could devote to the project and the additional barrier of the Atlantic Ocean.

Preliminary imaging in Scotland did build strong relationships among and between team members and institutional stakeholders, and, furthermore, the Livingstone team used communications technology (email, teleconferences, Skype, file-sharing sites) to maintain these relationships and to draw expertise available to the project through the project term. However, a number of problems encountered during the spectral imaging phase in Scotland, including a large project footprint, might have been mitigated by a more comprehensive site survey. Additionally, regularly scheduled teleconferences as well as shorter briefings focused on bridging disciplinary divides might have enhanced communication among team members during all stages of the project.

3. File Naming

Initially, the team planned to deliver the final products (the data archive and the critical edition of the diary) to coincide with the 140th anniversary of the Nyangwe Massacre on 15 July 2011. However, a series of production delays associated with new image processing and data management challenges prevented the team from working to schedule. Processing carbon inks on paper with different spectral responses required additional experimentation and development of refined techniques from those used previously on palimpsests. Data management challenges all led back to the complexity built into the spectral image file naming scheme devised by the team (see above). Fortunately, the 140th anniversary of the Livingstone-Stanley meeting offered a viable alternative publication date – first, because the anniversary also fell within the NEH and British Academy grant periods, and, second, because the 1871 Field Diary leads up to that meeting and even contains evidence that may help scholars determine the date of the meeting.

That said, the team could have avoided these delays. The need to have simple spectral image file names represents one of the major lessons learned of the project.

Future Projects and Follow-Up Work

As our Compliance Matrix illustrates (see Appendices), the David Livingstone Spectral Imaging Project met or exceeded nearly all project goals set out in the original grant application, including the development of a suitable interface to provide access to all the primary and secondary data produced by the project. Moreover, despite setbacks, the team still met these goals within the NEH grant period, which ended on 31 October 2011 – i.e., one day prior to the project results release date. However, due to the complexity of the user interface and the last-minute challenges that arose in its creation, the Livingstone team decided to consider the 1 November 2011 releases of the electronic edition and spectral image archive as beta versions, with final releases to be made in the spring of 2012. This second release phase will allow the team to enhance the interface further, develop RDF metadescrptors so that the site can be submitted to NINES for peer review (one of the few original goals that the project team did not meet), and put out one final project announcement that will be targeted primarily to scholars.

In addition to the work completed, the Livingstone Project has also laid the foundation for a number of future collaborative projects:

- The project established solid working relationships among the scholarly and scientific team members, and between the team and institutional representatives from the David Livingstone Centre, the National Library of Scotland, and the UCLA Digital Library. These relationships represent the basis for future projects on Livingstone, especially as the former two institutions boast major holdings related to the explorer, while the latter offers the ideal site to publish the work of new projects.
- The team has already collected the raw spectral data needed to support projects on Livingstone's 1870 Field Diary (a.k.a. the Bambarre Field Diary) and select letters from the 1871 as well as Sir John Franklin's 1821 Field Diary.
- Finally, Harrison has created an innovative outreach program for British schoolchildren based on the project to be piloted in collaboration with the David Livingstone Centre.

These initiatives – which offer a number of possibilities for the team to continue its transatlantic, scholarly-scientific-institutional collaborations – help to realize one of the overarching objectives of the team's original NEH grant, the "Digital Humanities *Start-Up* Grant" (emphasis added).

Appendices – List of Items

1. NEH Compliance Matrix
2. Project team
3. Livingstone's 1871 Field Diary: Sample folio, before and after processing
4. Website screen captures
5. Press releases: initial imaging (July 2010), academic (May 2011), data release (Nov. 2011)
6. Press coverage for the Livingstone Spectral Imaging Project
7. Google Analytics: indicative project site traffic prior, during, and after project data release/UK tour

The Nyangwe Diary of David Livingstone: Restoring the Text

NEH Compliance Matrix

Proposal	General Comments	Compliance (Fail, Limited, Meets, Exceeds)	Status (Planned, Not Planned, In Work, Completed.)
NEH Proposal: Enhancing the Humanities Through Innovation			
<p>A pilot project:</p> <ul style="list-style-type: none"> • New processes and technologies to spectrally image the Nyangwe field diary • Process the resulting image data with open source software to recover text of the diary. • Publish online a critical edition • Image database so unredacted diary is accessible to scholars • Both marked up transcription and processed images. 	<p>Imaging completed;</p> <p>Processing completed – open source by Bill; PCA Roger; pseudocolor Keith;</p> <p>Publication completed;</p> <p>Database completed;</p> <p>Markup completed</p>	Meets	Completed
<p>Break new ground in advanced digital imaging and data management:</p> <ul style="list-style-type: none"> • Extend the use of the spectral imaging from medieval palimpsests to faded nineteenth-century paper manuscripts • identify optimal imaging techniques for a nineteenth century paper manuscript • educating scholars of the nineteenth century on the potential of the new technology for their field. • cross-disciplinary collaboration in the technical processing and scholarly study of digitized cultural objects • data will be marked up with all metadata needed for retrieval, scholarly and scientific analysis, <i>and</i> interoperability with related projects. 	<p>Spectral completed;</p> <p>Optimal technique assessment completed;</p> <p>Education initial completed; continuing;</p> <p>Collaboration initial completed; continuing</p> <p>Markup completed</p>	Meets	Completed
<p>The project will be developed through a scholar-scientist-institution transatlantic collaboration.</p>	Ongoing	Meets	Completed

Proposal	General Comments	Compliance (Fail, Limited, Meets, Exceeds)	Status (Planned, Not Planned, In Work, Completed,)
Start-up Activities and Goals			
Spectrally imaging the field diary and processing the images to reveal Livingstone's faded handwriting over the printed text of <i>The Standard</i> , as well as any erasures or corrections.	Also imaged Livingstone 1870 diary and selected letters at NLS as well as Franklin 1821 field diary and sampling of Byron letters	Exceeds	Completed
Separate Livingstone's writing from the printed undertext, and reveal and clarify the overtext.	Completed	Exceeds	Completed
Quantify the ink and provide spectral properties and samples to ink databases in the Library of Congress and U.S. law enforcement community.	Quantification completed with spectral analysis continuing by Library of Congress initially	Meets	In Work
If needed, contacts in the U.S. forensics community will be asked to provide advice and guidance on the processing and enhancement of the ink(s).	Initial contact made through Library of Congress, continuing	Limited	In Work
Bring equipment from the U.S. and image the diary in two phases: <ul style="list-style-type: none"> • Standard Imaging uses proven hardware and techniques developed for the Archimedes Palimpsest to digitally capture images in 13 narrow bandwidths and with raking lights. • Experimental Imaging exploits new optics and processing techniques that may offer the best potential to reveal the overtext on paper. 	Standard completed; additional Livingstone texts imaged; experimental completed, limited to new processing techniques, raking and transmitted due to extra texts	Exceeds	Completed
Enhance the imaging and processing software with open source software to allow follow-up processing by scientists and scholars around the globe.	Bill Christens-Barry developed ImageJ toolbox	Meets	Completed
Provide metadata, access, and data management: <ul style="list-style-type: none"> • transcribing the overtext of the Nyangwe field diary • producing a multidisciplinary critical apparatus, • encoding the transcriptions and apparatus in XML, 	Text transcribed; multidisciplinary critical apparatus completed; transcriptions, but not apparatus encoded in XML; text display tools completed, but further	Meets	Completed

Proposal	General Comments	Compliance (Fail, Limited, Meets, Exceeds)	Status (Planned, Not Planned, In Work, Completed,)
<ul style="list-style-type: none"> developing the appropriate tools for the online display of the texts, and making the product available to the public by July 15, 2011. 	<p>enhancements planned;</p> <p>product made available to public Nov. 1, 2011</p>		
<p>Transcribing, editing, and encoding the texts will follow practices already developed for the Livingstone epistolary materials published on <i>Livingstone Online</i></p>	<p>Livingstone Online TEI P4 practices updated to P5 and tailored to specific characteristics of diary</p>	Exceeds	Completed
<p>The XML markup of the transcriptions will conform to guidelines established by the Text Encoding Initiative (TEI).</p>	<p>Consulted with TEI authorities</p>	Meets	Completed
<p>Online display will allow readers to organize, sort, and retrieve the material according to their needs.</p>	<p>Text search and image display tools completed, but further enhancements planned</p>	Limited/Meets	Completed
<p>The transcriptions will recreate the original texts as closely as possible and will be in diplomatic format, thereby giving access—at user discretion—to any cancellations or other modifications Livingstone may have introduced in the process of writing.</p>	<p>XML TEI P5 transcriptions produced in diplomatic format; further enhancements to display tools planned to allow for viewing of cancellations and other modifications, and editorial interventions</p>	Limited/Meets	Completed
<p>Readers will also be able to (1) consult Livingstone's entries by document, date, or continuous chronological series, (2) compare the corresponding entries in the diary and Livingstone's "Unyanyembe Journal," and (3) read the transcriptions alongside the images.</p>	<p>Readers can also read the published version of the 1874 Journals alongside the 1871 field diary and the "Unyanyembe Journal"</p>	Exceeds	Completed
Ultimate Results and Importance of Proposed Work			
<p>Standardize both work processes to support the efficient flow of data <i>and</i> formats for data delivery to scholars and the broader community with open source software.</p>		Meets	Completed
<p>For long- term digital preservation, the images and transcriptions will be hosted on the Internet in "flat files" that are not dependent on any specific GUI.</p>		Meets	Completed

For immediate and follow-up studies, all data and metadata will be hosted on servers for digital analysis of the image products.		Meets	Completed
By preserving Livingstone's work in multiple locations, the pilot project will make Livingstone's field diary and journals freely accessible to the public, thus contributing to conservation by reducing the need for handling the original documents.	Currently data only available through UCLA, but further distribution/hosting planned	Limited	Completed
Work Plan			
The work will be carried out over an eighteen-month period and will explore two viable options to recover Livingstone's handwritten overtext:	Completed	Meets	Completed
1. Spectral imaging and processing to use the spectral differences to suppress the undertext and enhance the overtext. This is the most mature technique with known risk and opportunity for timely results.	Imaging and processing completed	Meets	Completed
2. Computer separation of the handwritten over text by subtracting the printed undertext with a clean copy of the particular issue of <i>The Standard</i> . A key challenge will be registration of the clean copy and the overwritten copy. This procedure will require quality scans of <i>The Standard</i> and the labor-intensive warping and stretching of the two images (the diary and <i>The Standard</i>) so that fiduciary points match up. This technique could require significant new technology integration, with higher risk. The imaging team will collaborate with forensics experts.	24 November 1869 issue of Standard images collected and hosted, separation difficult due to registration issues; technique not needed because processing fully revealed Livingstone's text	Limited	Completed
<u>Image Collection.</u> In addition to the Standard Imaging, up to six experimental imaging techniques may also be used: 1. Fluorescence emission imaging with spectral illumination from above and a color filter wheel. 2. UV reflectance with spectral illumination from above and a UV transparent lens and UV filter.	Experimental limited due to extra text to: transmitted, raking, spectrometry	Limited	Completed

<p>3. Transmissive imaging with normal spectral illumination from above and reflective substrates.</p> <p>4. Transmissive imaging with spectral illumination from below through a transparent table.</p> <p>5. Raking light or Polynomial Text Mapping (PTM) using spectral illumination at multiple points around the object, supporting development of a new technique with this system.</p> <p>6. Nonimaging Spectrometry using an Ocean Optics spectrometer.</p>			
<p><u>Image Processing.</u> Render pseudocolor images from the spectral images, following an initial survey of the spectral responses of the inks. The pseudocolor images will be constructed by a process developed during the Archimedes Palimpsest project and since refined. The processed image is a combination of the UV fluorescence image and the image from a red illumination.</p>	Pseudocolor completed	Meets	Completed
<p>We also propose to apply principal component analysis (PCA) to these images, which maximizes the data variance in the images to enhance contrast between principal components.</p>	PCA completed	Meets	Completed
<p>Transmissive imaging and PTM may also offer new techniques for separating texts in different inks on paper.</p>	Limited experimental due to extra text	Limited	Completed
<p>Core image processing operations will make use of the open source software package ImageJ.</p>	ImageJ toolbox hosted	Meets	Completed
<p>Specialized tools that we have implemented to streamline our particular workflows, operations, and quantitative analyses include:</p> <ul style="list-style-type: none"> • File manipulation routines to handle the key formats (multispectral TIFF and DNG image cubes), precisions (8-, 16-, and 32-bit integer and floating point), and large file sizes (up to 1.3 Gigabyte); 	Development continuing	Meets	Completed

<ul style="list-style-type: none"> • Fundamental data operations to perform flat fielding, local normalization, color reconstruction • and display, basic calibration, and advanced quantitative processing; • Highly specialized computational algorithms for quantitative image processing operations (pseudocolor, spatial filtering, PCA, local and kernel operators, logical and linear image algebra); • Metadata creation and inspection, and archival manipulation tools, which work in conjunction with tools and structures furnished by our data manager, Doug Emery. 			
<p><u>Data Management.</u> Provide a complete package of images with documentation and full metadata. The resulting archive data set will be based on the archive and metadata model used for the Archimedes Palimpsest. The product will be a completely self-documenting and autonomous data set.</p>	Completed	Meets	Completed
<p>The collection of the appropriate metadata will require planning before, collection during, and organization after the imaging sessions. Metadata collection will be conducted as part of the imaging with the MegaVision PhotoShoot software that controls the image collection.</p>	Planned, collected and organized. Metadata integration after imaging and during processing required additional effort.	Meets	Completed
<p>After imaging and processing is completed, the imaging logs will be collated with other required metadata to generate complete metadata records for raw and processed images, and to assemble the final data archive. This will be a full digital archive of images that meets library and archival standards.</p>	Log integration after imaging and during processing required additional effort	Meets	Completed
<p>The archive will be hosted by <i>Livingstone Online</i>.</p>	Archive hosted by UCLA due to technical and funding difficulties with Livingstone Online	Meets	Completed
<p>Backup data hosting will be facilitated by <i>The Early Manuscripts Electronic Library</i>.</p>	EMEL arranged alternate hosting arrangement with UCLA	Meets	Completed

<p><u>XLM Markup and the Digital Product.</u> The Livingstone Journal Digital Product will include XML tagged and marked up images and transcriptions produced as follows:</p>	<p>TIFF conversion completed; transcription and XML tagging completed</p>	<p>Meets</p>	<p>Completed</p>
<p>1. All images will be converted to TIFF, with all metadata included in the header of the TIFF images, including spectral and spatial metadata.</p>		<p>Meets</p>	<p>Completed</p>
<p>2. Wisnicki and Harrison will transcribe the text from the images and identify and mark up significant content elements (e.g., names, places, key terms).</p>		<p>Meets</p>	<p>Completed</p>
<p>3. The transcriptions will be marked up with metadata in XML format. This will include spatial data, with tags linking each line of text to the line on the image for the appropriate text.</p>	<p>Metadata completed. Spatial data will be completed by the end of February 2012.</p>	<p>Meets</p>	<p>Completed/In Work</p>
<p>4. With metadata in the header of the TIFF images, we will produce XML tagged TIFF image products of the journal images for all imaging modalities, registered as much as possible.</p>		<p>Meets</p>	<p>Completed</p>
Staff			
<p>Wisnicki will devote approximately one-third of his time to producing and marking up the transcriptions. He will submit the completed project to NINES for peer review ensure that the results of the project are properly integrated with other relevant materials on <i>Livingstone Online</i>. Harrison will devote approximately one-fourth of her time to the project and assist in producing and marking up the transcriptions of Livingstone's text. Toth will manage the imaging effort and the team of imaging scientists (Christens-Barry, Easton, Knox) who will conduct the imaging and image processing during a 12-month period. Emery will provide overall data management and ensure metadata and data meet TEI and other applicable standards. Phelps will serve as grant administrator.</p>	<p>Completed</p> <p>Change in personnel on site for added imaging support</p> <p>Additional time and effort required and provided for data and program management</p> <p>Project not yet submitted to NINES, but submission planned for late spring 2012</p> <p>Toth developed and tracked program documentation and schedules</p> <p>Emery developed and implemented extended data architecture and integrated data from multiple sources</p>	<p>Exceeds (except for NINES)</p>	<p>Completed</p>

Final Product and Dissemination			
The full set of data produced by the present project will be made available through <i>Livingstone Online</i> and, through the assistance of <i>The Early Manuscripts Electronic Library</i> , in on-line backups and mirror sites.	Archive hosted by UCLA due to technical and funding difficulties with Livingstone Online; further distribution and hosting of data planned	Meets	Completed/In Work
We will distribute press releases at key project milestones,	First release with initial imaging; second with data release; also intermediary academic release	Exceeds	Completed
We will hold a formal event on July 15, 2011, at the David Livingstone Centre.	Formal events held at NLS, DLC, and Birkbeck College, November 2011	Exceeds	Completed
The project white paper will report innovations in image capture and image processing, data management, and workflow processes, and describe lessons-learned from scholar-scientist collaboration, integration of cross-disciplinary data, and dissemination through a broad range of media.	Major program documentation included on Web site. Program documentation and additional documentation presented in White Paper and Final Performance Report. Invited NEH presentation on publicizing the project, Directors Meeting, Sept. 2010; Possible NEH presentation as well.	Exceeds	Completed

Livingstone Spectral Imaging Project - Team

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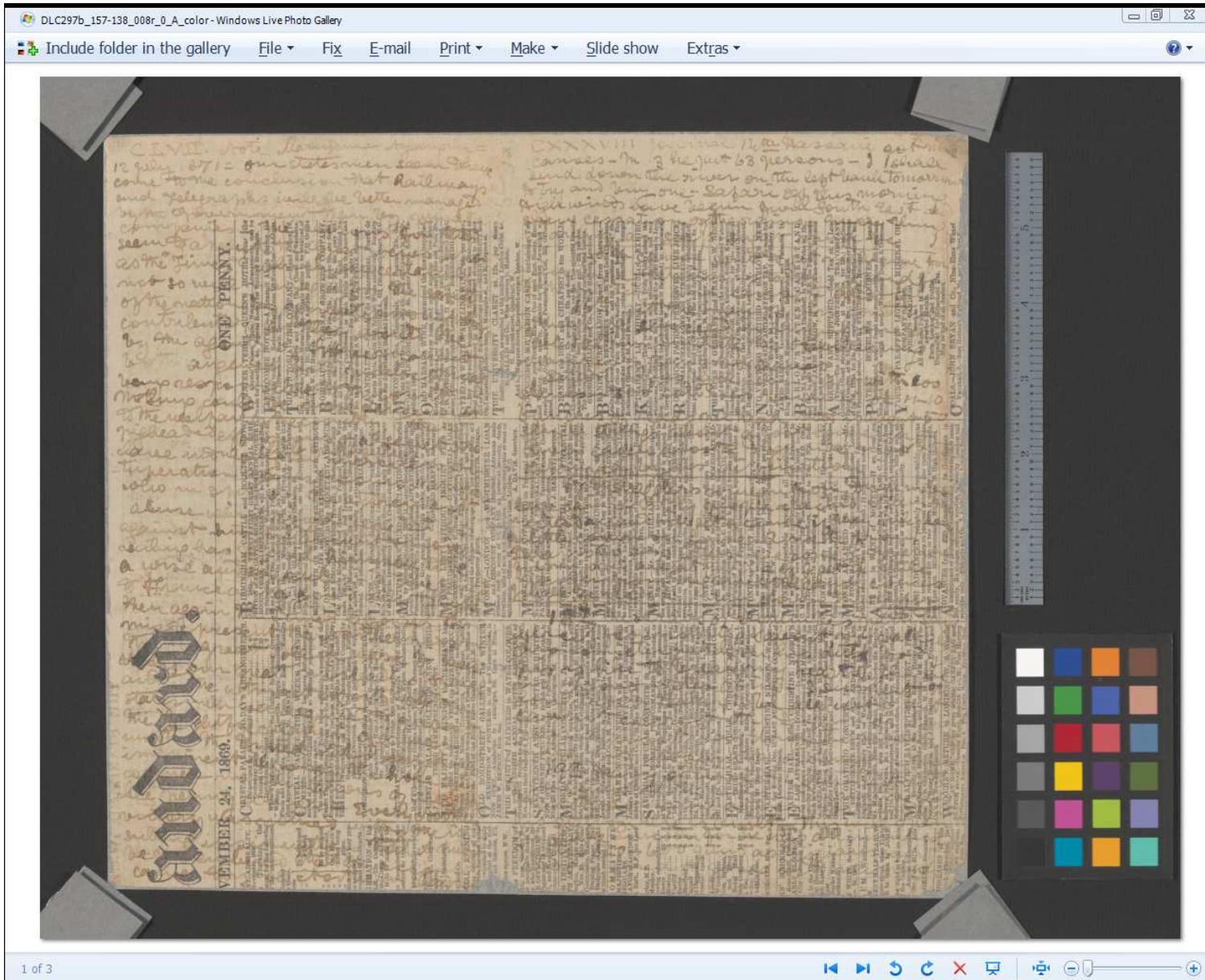
University College London

Michael Phelps

Early Manuscripts Electronic Library

Hilary Fraser

Birkbeck, University of London



Livingstone's 1871 Field Diary: Sample Page, Natural Light



Livingstone's 1871 Field Diary: Sample Page, Processed Spectral Image



Livingstone Spectral Imaging Project: Home Page

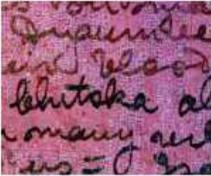
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Livingstone's 1871 Field Diary

A Multispectral Critical Edition

site key: [texts & references](#) [terminology](#) [numerals](#) [acronyms](#)

Home Page

- [Site Guide](#)
- [Manuscript Guide](#)
- [Project Team](#)
- [Acknowledgments](#)

Livingstone & the Manuscript

- [Livingstone in 1871](#)
- [The Manuscript](#)
- [Bibliography](#)

The 1871 Field Diary

- [Images & Transcriptions](#)
- [Color & Spectral Images](#)
- [Three Text Versions](#)
- [Third Massacre Narrative](#)
- [Search the Diary](#)

Critical Notes

- [Terms, People, Places](#)
- [Manuscript Composition](#)
- [Manuscript Structure](#)
- [Livingstone-Stanley Meeting](#)
- [Note on Text Versions](#)

Introduction

The publication of *Livingstone's 1871 Field Diary: A Multispectral Critical Edition* reveals for the first time the original record of a remarkable and traumatic period in the life of David Livingstone, the celebrated British abolitionist, missionary, and explorer of Africa. The date of publication coincides almost exactly with the date Livingstone completed this diary in Central Africa 140 years ago. The original, previously unpublished text of the diary has remained inaccessible until now, due to the fragility of the paper and the near-illegible script. [The David Livingstone Spectral Imaging Project](#) has restored the full text of the diary by using cutting-edge spectral imaging and processing technology, and now makes the diary available through this electronic edition.



Livingstone's 1871 Field Diary: Home Page

Livingstone's 1871 Field Diary - Index - Mozilla Firefox

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Livingstone's 1871 Field Diar... +

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[Image Credits](#)

[Spectral Image Archive](#)

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This is a beta version of the critical edition. The final version will be published spring 2012.

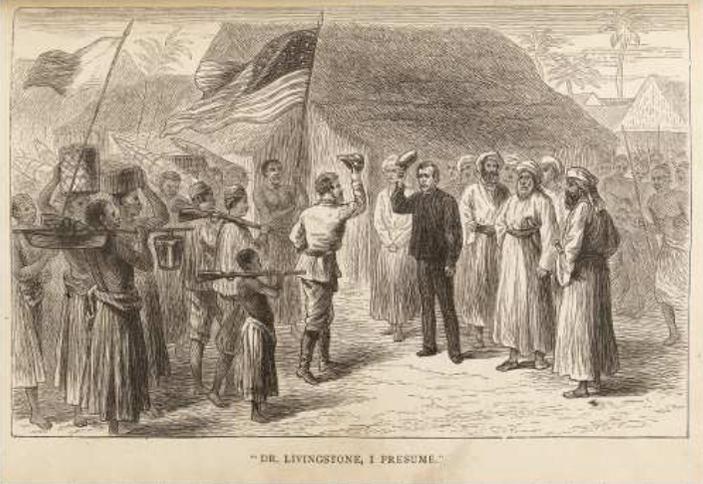
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The massacre horrified Livingstone, leaving him too shattered to continue his mission to find the source of the Nile. He traveled 240 miles from Nyangwe – violently ill most of the way – back to Ujiji, an Arab settlement on the eastern shore of Lake Tanganyika. Here, Henry Morton Stanley, a reporter sent by the New York Herald to locate Livingstone (who had been "missing" for several years and presumed dead) found the Scottish explorer and greeted him with the iconic words, "Dr. Livingstone, I presume?"



"DR. LIVINGSTONE, I PRESUME."

Figure 3. "Dr. Livingstone, I Presume?" Illustration from Stanley 1872.2:opposite 412. [Download a high-resolution TIFF](#)

Transferring data from livingstone.library.ucla.edu... The rest is history. The meeting, one of the most famous encounters in the

Livingstone's 1871 Field Diary: Sidebar showing NEH acknowledgment

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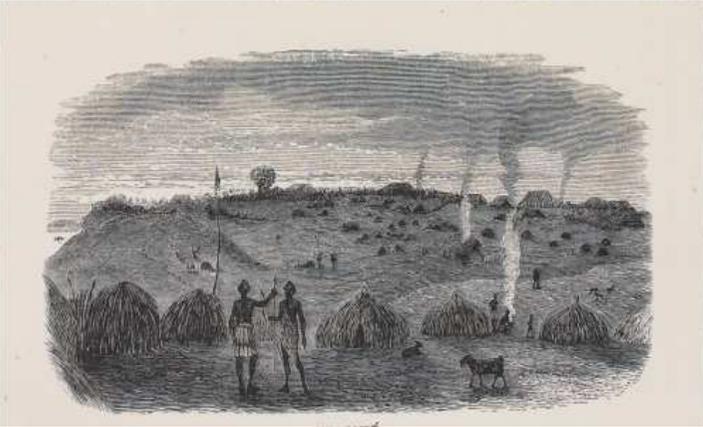
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A Multispectral Critical Edition

site key: [texts & references](#) [terminology](#) [numerals](#) [acronyms](#)

The Village of Nyangwe

The nineteenth century witnessed the consolidation of an Arab-African trading network across East Africa, and the gradual expansion of this network into the Congo in the search of new ivory fields. "[...]There were not only places where goods were stored and people gathered, such as ports and a few large markets," writes Catherine Coquery-Vidrovitch (2005:210), "but many smaller centers that we still know little about. The smaller centers may have moved from place to place and served as caravan stops, portage resting points, military posts, and slave markets on a more or less temporary basis. Together they made up a complete, structured trade network." Nyangwe played a key role in this network.



Home Page

- [Site Guide](#)
- [Manuscript Guide](#)
- [Project Team](#)
- [Acknowledgments](#)

Livingstone & the Manuscript

- [Livingstone in 1871](#)
- [The Manuscript](#)
- [Bibliography](#)

The 1871 Field Diary

- [Images & Transcriptions](#)
- [Color & Spectral Images](#)
- [Three Text Versions](#)
- [Third Massacre Narrative](#)
- [Search the Diary](#)

Critical Notes

- [Terms, People, Places](#)
- [Manuscript Composition](#)
- [Manuscript Structure](#)
- [Livingstone-Stanley Meeting](#)
- [Note on Text Versions](#)
- [Note on Spectral Images](#)
- [XML Coding Practices](#)

Project History & Archive

- [Initial History](#)

Livingstone's 1871 Field Diary: from section on "Livingstone in 1871"

Livingstone's 1871 Field Diary - Transcription - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Livingstone's 1871 Field Diar... +

livingstone.library.ucla.edu/1871diary/transcriptions.htm

Google

297c/102

Page 297c/102

1 CII - to be copied into journal at Ujiji now
 2 23rd March 1871 Left Kasongo - he gave a
 3 goat & guns & c - country gently undulating
 4 shewing green slopes fringed with wood
 5 Grass from 4 to 6 feet = Luamba or
 6 cotton meadow grass- Nyassi in patches
 7 reached Katenga's about 6 miles off
 8 many villages & people passed us
 9 carrying loads of provisions - cassava
 10 from the chitoka or market - soil
 11 a little sandy - allows good drainage
 12 24th = Great rain in the night &
 13 morning - and sickness of
 14 men prevented our march
 15 25th - Went to Marimwe 7 1/2 [1/2]
 16 miles off - many hamlets at
 17 each station = country undulating
 18 and grassy - trees scarce
 19 Patches of Arum at every
 20 village and cassava far
 21 off on account of the pigs
 22 which are now plenty - a
 23 black ugly pig - crossed a rivulet &
 24 the Lohemba -
 25 26th - Went four miles and crossed the
 26 Kabwe maji - the [then] a mile beyond Kahembai
 27 which flows into the Kunda and it
 28 into Lualaba - country open and
 29 low hills appear in the North - We
 30 met a party from the traders at Kasongo
 31 chiefly Matereka's people- Salem & Seyd
 32 bin Sultan - They had eighty two captives
 33 say they fought ten days to secure
 34 them and two Malonwana & two of the

Livingstone's 1871 Field Diary: Processed Image and Transcription

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File Edit View History Bookmarks Tools Help

Livingstone's 1871 Field Diar... +

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Livingstone & the Manuscript

- Livingstone in 1871
- The Manuscript
- Bibliography

The 1871 Field Diary

- Images & Transcriptions
- Color & Spectral Images
- Three Text Versions
- Third Massacre Narrative
- Search the Diary

Critical Notes

- Terms, People, Places
- Manuscript Composition
- Manuscript Structure
- Livingstone-Stanley Meeting
- Note on Text Versions
- Note on Spectral Images
- XML Coding Practices

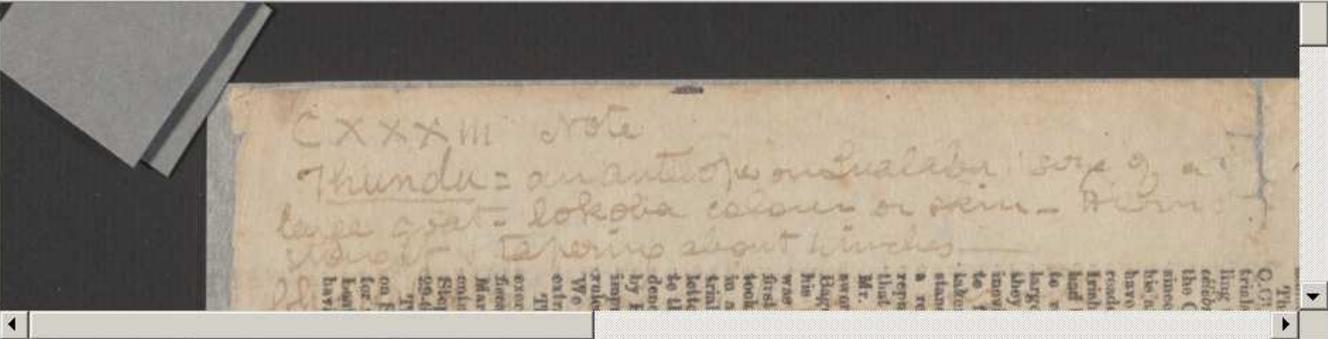
Project History & Archive

- Initial History
- Project Planning
- Spectral Imaging
- Image Processing
- Data Management
- Restoring the Text
- Analysis to Dissemination
- Lessons & Future Projects

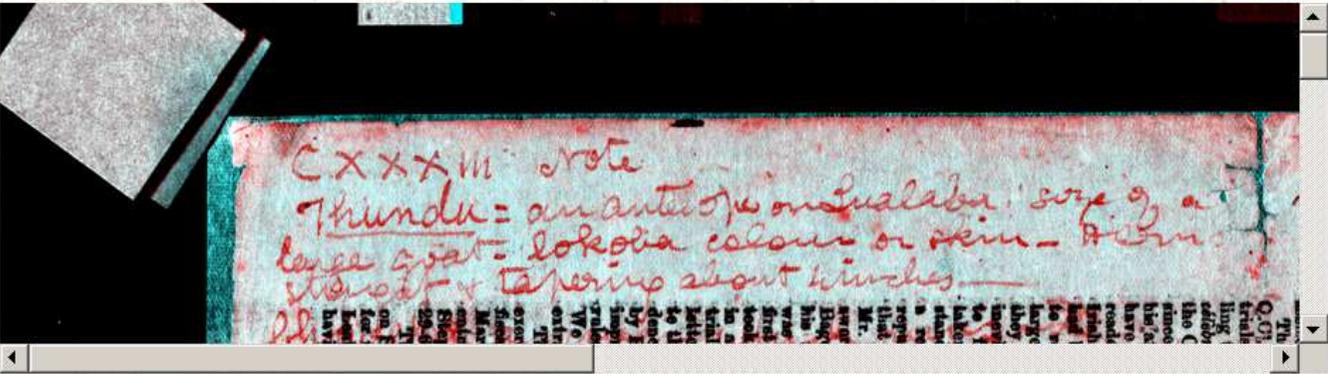
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CXXXIII note
Thundu = an antelope on Qualaba side of a
large goat = lokaola colour or skin - African
It is a ... tapering about inches



CXXXIII note
Thundu = an antelope on Qualaba side of a
large goat = lokaola colour or skin - African
It is a ... tapering about inches

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Livingstone's 1871 Field Diary - three versions - Mozilla Firefox

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Livingstone's 1871 Field Diar... +

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Google

Home Page

- [Site Guide](#)
- [Manuscript Guide](#)
- [Project Team](#)
- [Acknowledgments](#)

Livingstone & the Manuscript

- [Livingstone in 1871](#)
- [The Manuscript](#)
- [Bibliography](#)

The 1871 Field Diary

- [Images & Transcriptions](#)
- [Color & Spectral Images](#)
- [Three Text Versions](#)
- [Third Massacre Narrative](#)
- [Search the Diary](#)

Critical Notes

- [Terms, People, Places](#)
- [Manuscript Composition](#)
- [Manuscript Structure](#)
- [Livingstone-Stanley Meeting](#)
- [Note on Text Versions](#)
- [Note on Spectral Images](#)
- [XML Coding Practices](#)

Project History & Archive

- [Initial History](#)
- [Project Planning](#)
- [Spectral Imaging](#)
- [Image Processing](#)
- [Data Management](#)

1871 Field Diary

Search:

Page C/I

1	CII - to be copied into journal at Ujiiji now
2	23 rd March 1871 Left Kasongo - he gave a
3	goat & guns &c - country gently undulating
4	showing green slopes fringed with wood
5	Grass from 4 to 6 feet = Luamba or
6	cotton meadow grass- Nyassi in patches
7	reached Katenga's about 6 miles off
8	many villages & people passed us
9	carrying loads of provisions - cassava
10	from the chitoka or market - soil
11	a little sandy - allows good drainage
12	24 th = Great rain in the night &
13	morning - and sickness of
14	men prevented our march
15	25 th Went to Marimwe 7½ [1/2]
16	miles off- many hamlets at
17	each station = country undulating
18	and grassy - trees scarce
19	Patches of Arum at every
20	village and cassava far
21	off on account of the pigs
22	which are now plenty - a
23	black ugly pig - crossed a rivulet &
24	the Lohemba -
25	26 th Went four miles and crossed the
26	Kabwe maji - the [then] a mile beyond
27	Kahembai
28	which flows into the Kunda and it
29	into Lualaba - country open and
30	low hills appear in the North - We
31	met a party from the traders at Kasongo
32	chiefly Matereka's people- Salem & Seyd
33	bin Sultan- They had eighty two captives
34	say they fought ten days to secure
	them and two Malongwana & two of the

Unyanyembe Journal (1872)

Search:

Page 660

1871 March 23rd Left Kasonga's - He gave me a goat & a guide - country gently undulating showing fine green slopes fringed with green wood trees = grass from 4 ft to 6 feet high - Luamba or cotton meadow grass general and Nyassi in patches - came to Katenga village about 5 miles off - many villages & many people passed going to market with loads of provisions - soil a little sandy allows good drainage

24th Great rain by night, and sickness of men who as slaves take great care of themselves a little headache prevents our march -

25th Went to Mazimwe about 7½ miles off country undulating and grassy- trees scarce - Patches of shrubs or Aruba? appear at every village - cassava far off on account of the pigs which are abundant: cross

26th Pull Lo hember - then four miles and cross Kabwemadgi Rt - then a mile beyond it the Rt Kahembai which flows into the Kunda and it into Lualaba - The great river being on our left - country open and low hills appear - in N. We now met a party of men from the traders at Kasenga's - Salem bin Mukadam and Seyd bin Sultan and counted eighty two captives they had caught them by fighting ten days with the people of Surampela on the left bank of Lualaba - They were hired to go against them by the chief Chinanne

Last Journals (1874)

Search:

Page 109

1871.] *Marching Through Manyuema.* 109 23rd March.—Left Kasongo, who gave me a goat and a guide. The country is gently undulating, showing green slopes fringed with wood, with grass from four to six feet. We reached Katenga's, about five miles off. There are many villages, and people passed us carrying loads of provisions, and cassava, from the chitoka or market. 24th March.—Great rain in the night and morning, and sickness of the men prevented our march. 25th March.—Went to Mazimwé, 7½ miles off. 26th March.—Went four miles and crossed the Kabwimaji; then a mile beyond Kahembai, which flows into the Kunda, and it into the Lualaba; the country is open, and low hills appear in the north. We met a party from the traders at Kasenga, chiefly Materéka's people under Salem and Syde bin Sultan; they had eighty-two captives, and say they fought ten days to secure them and two of the Malongwana, and two of the Banyamwezi. They had about twenty tusks, and carried one of their men who broke his leg in fighting; we shall be safe only when past the bloodshed and murder. 27th March.—We went along a ridge of land overhanging a fine valley of denudation, with well-cultivated hills in the distance (N.), where Hassani's feat of bloodshed was performed. There are many villages on the ridge, some rather tumbledown ones, which always indicate some misrule. Our

Page 110

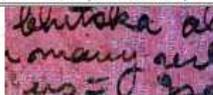
110 *Livingstone's Last Journals.* [Chap. [Chapter] IV. march was about seven miles. A headman who went with us plagued another chief to give me a goat, I refused to take what was not given willingly, but the slaves secured it, and I threatened our companion, Kama, with dismissal from our party if he became a tool in slave hands. The arum is common. 28th March.—The Banian slaves are again trying

Livingstone's 1871 Field Diary: Three Versions of the Text

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A Multispectral Critical Edition

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Search the 1871 Field Diary

Use the boxes below to search the text of the 1871 Field Diary. An "empty" search in any but the Keyword box will produce a list of all terms marked up in the XML files under the given category.

Keyword:

Date:

People:

Tribes and Villagers:

Foreign Words or Phrases:

Places & Geographical Entities:

- Home Page**
 - [Site Guide](#)
 - [Manuscript Guide](#)
 - [Project Team](#)
 - [Acknowledgments](#)
- Livingstone & the Manuscript**
 - [Livingstone in 1871](#)
 - [The Manuscript](#)
 - [Bibliography](#)
- The 1871 Field Diary**
 - [Images & Transcriptions](#)
 - [Color & Spectral Images](#)
 - [Three Text Versions](#)
 - [Third Massacre Narrative](#)
 - [Search the Diary](#)
- Critical Notes**
 - [Terms, People, Places](#)
 - [Manuscript Composition](#)
 - [Manuscript Structure](#)
 - [Livingstone-Stanley Meeting](#)
 - [Note on Text Versions](#)
 - [Note on Spectral Images](#)
 - [XML Coding Practices](#)
- Project History & Archive**
 - [Initial History](#)

Livingstone's 1871 Field Diary: Search Page

Livingstone's 1871 Field Diary - Manuscript Composition, page 3 - Mozilla Firefox

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Additional Diary Pages

Livingstone's use of ink in the additional diary pages covered by this critical edition is much more complex, due partly to the different kinds of paper employed. In natural light, ink hue across the different folia and between these folia and those with the DLC297c and DLC297b file prefixes seems not to be consistent.

Visual examination suggests that Livingstone has covered the folio under file prefix NLS10703 with a variety of inks. The heterogenous nature of the material here – including diary entries that follow directly from DLC297b/163, astronomical calculations (10 March to 15 July 1871), the summary of "Total Rainfall in Manyema 1870-71" (October 1870 to 15 November 1871), and one brief set of undated notes in pencil – also indicates that Livingstone may have written the text on these folia over a long period of time. The [ink spectra](#) for these folia reinforce this point.

The graph, titled "Spectral Profile of NLS10703_001_036r", plots Reflectance (y-axis, 0.0 to 1.0) against Wavelength (x-axis, 500 to 900 nm). It displays several distinct curves representing different ink samples. The curves generally show an upward trend in reflectance as wavelength increases, with some samples exhibiting a more pronounced slope than others, indicating differences in ink composition.

Livingstone's 1871 Field Diary: Manuscript Composition

Livingstone's 1871 Field Diary - Spectral Imaging, page 1 - Mozilla Firefox

File Edit View History Bookmarks Tools Help

livingstone.library.ucla.edu/1871diary/spectral_imaging1.htm

Google

Home Page

- [Site Guide](#)
- [Manuscript Guide](#)
- [Project Team](#)
- [Acknowledgments](#)

Livingstone & the Manuscript

- [Livingstone in 1871](#)
- [The Manuscript](#)
- [Bibliography](#)

The 1871 Field Diary

- [Images & Transcriptions](#)
- [Color & Spectral Images](#)
- [Three Text Versions](#)
- [Third Massacre Narrative](#)
- [Search the Diary](#)

Critical Notes

- [Terms, People, Places](#)
- [Manuscript Composition](#)
- [Manuscript Structure](#)
- [Livingstone-Stanley Meeting](#)
- [Note on Text Versions](#)
- [Note on Spectral Images](#)
- [XML Coding Practices](#)

Project History & Archive

- [Initial History](#)
- [Project Planning](#)
- [Spectral Imaging](#)
- [Image Processing](#)

Spectral Imaging in Scotland

Spectral imaging, when used for the study of cultural objects, involves illuminating an object with successive wavelengths of light – starting with ultraviolet, working through the visible spectrum, and concluding with infrared – then digitally photographing the resulting illuminations. The produced images all have exactly the same pixel dimensions, and are spatially registered, the content being equivalent at each pixel location in each image. Later, imaging scientists process this data in order to enhance select features of the cultural object.

Visit the related section from [Livingstone's Letter from Bambarre](#).



Livingstone's 1871 Field Diary: selection from Project History & Archive

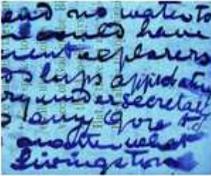
Livingstone Spectral Image Archive - Mozilla Firefox

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livingstone.library.ucla.edu/livingstone_archive/

UCLA Library > Digital Collections > David Livingstone > Spectral Image Archive



Livingstone Spectral Image Archive

[Project Home Page](#)

The David Livingstone Spectral Image Archive contains images and XML transcriptions of the folia that constitute the Manyema Diary (1870-71) and select letters (1871) of David Livingstone, the British missionary and explorer of Africa.

The original manuscripts appear among the holdings of the Bodleian Libraries (University of Oxford), the David Livingstone Centre, the National Library of Scotland, and the Peter Beard Studio. The Archive brings together these manuscripts for the first time since the nineteenth century.

All images are licensed for

The David Livingstone Spectral Image Archive is designed to be self-documenting for human and automated access, and provides data and metadata in a regular and predictable structure. For details, see the [0_ReadMe](#) file ([.txt](#) or [.pdf](#)).

Name	Last modified	Size
Parent Directory		-
Data/	12-Dec-2011 10:29	-
Documents/	12-Dec-2011 10:50	-
ResearchContrib/	12-Dec-2011 10:42	-
Supplemental/	12-Dec-2011 10:43	-
Support/	12-Dec-2011 10:43	-
0_ReadMe.pdf	30-Oct-2011 02:56	37K
0_ReadMe.txt	30-Oct-2011 02:56	16K

Livingstone Spectral Image Archive: Home Page

Livingstone Spectral Image Archive - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Livingstone's 1871 Field Di... Livingstone Spectral Image... +

livingstone.library.ucla.edu/livingstone_archive/Data/DLC/DLC297c_107-128_003v/

Manyema Diary (1870-71) and select letters (1871) of David Livingstone, the British missionary and explorer of Africa.

The original manuscripts appear among the holdings of the Bodleian Libraries (University of Oxford), the David Livingstone Centre, the National Library of Scotland, and the Peter Beard Studio. The Archive brings together these manuscripts for the first time since the nineteenth century.

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Parent Directory			
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	DLC297c_107-128_003v_0_A_0365_packflat8.tif.md5	26-Sep-2011 02:15	78
	DLC297c_107-128_003v_0_A_0365_packflat8.tif.txt	26-Sep-2011 02:15	3.8K
	DLC297c_107-128_003v_0_A_0450_packflat8.tif	26-Sep-2011 02:15	37M
	DLC297c_107-128_003v_0_A_0450_packflat8.tif.md5	26-Sep-2011 02:15	78
	DLC297c_107-128_003v_0_A_0450_packflat8.tif.txt	26-Sep-2011 02:15	3.8K
	DLC297c_107-128_003v_0_A_0465_packflat8.tif	26-Sep-2011 02:15	37M
	DLC297c_107-128_003v_0_A_0465_packflat8.tif.md5	26-Sep-2011 02:15	78
	DLC297c_107-128_003v_0_A_0465_packflat8.tif.txt	26-Sep-2011 02:15	3.8K
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	DLC297c_107-128_003v_0_A_0638_packflat8.tif.txt	26-Sep-2011 02:16	3.8K

Livingstone Spectral Image Archive: Sample Directory

Embargoed: Friday 2 July 2010, 00:01 hours GMT

**Mission Impossible
Livingstone's darkest hour illuminated by spectral imaging**

For 140 years rare manuscripts that record the private thoughts and opinions of David Livingstone, the Victorian explorer and missionary, were hidden from the public eye due to their fragile condition and frequently indecipherable text. Today a trans-Atlantic academic and scientific team, comprising researchers from Birkbeck, University of London and US spectral imaging scientists, launches a major project with the publication of *Livingstone's Letter from Bambarre* – a spectrally-imaged 'lost' letter from Livingstone's final African expedition, written to his friend and future biographer Horace Waller.

In February 1871, while searching for the source of the Nile, Livingstone was living in extreme environmental conditions and as a virtual prisoner at Bambarre, a village in what is now the eastern part of the Democratic Republic of the Congo. He had run out of paper and would shortly run out of ink; so he improvised. He tore pages out of books and newspapers, writing around the margins and crosswise over the text; for ink he used pigment taken from the seeds of a local berry. While the printed text of the books and newspapers remain clear, Livingstone's text has faded, rendering virtually illegible the explorer's unique observations on the slave trade, on the prospects for commerce and Christianity in the African interior, and on the lake and rivers of Central Africa.

The paper used for *Livingstone's Letter from Bambarre* – pages torn from a proof copy of the *Proceedings of the Royal Geographical Society* – is yellowed and brittle. Livingstone's iron gall ink has bled through the page, in effect creating two layers of text superimposed on one another. This problem is compounded by Livingstone's method of writing, which weaves an unsteady course around the margins of the page before it meanders vertically across the horizontal print of the journal. With unintended irony, the disorientating text of the letter captures visually Livingstone's frail mental and physical state at this dark period in his life.

The publication of Livingstone's letter to Waller – from the private collection of the distinguished American photographer Peter Beard – marks the beginning of a major 18-month project, funded by the U.S. National Endowment for the Humanities (NEH) and the British Academy, to publish a critical edition and spectral image database of the diary and letters Livingstone wrote in 1870-71. Most of the fragmented pages of the diary have been carefully preserved at the David Livingstone Centre in Blantyre, which is managed by the conservation charity National Trust for Scotland, and the National Library of Scotland. The two organisations are collaborating with the Livingstone team of academics and scientists in order to bring the historical secrets these pages contain to the light of day. The Early Manuscripts Electronic Library in California is coordinating the spectral-imaging team.

The project will reveal, among other details, the full extent of Livingstone's ill health, his controversial and ever-evolving views on the source of the Nile, and the politics of African slavery and ivory trading – details suppressed by Waller, who edited the posthumously published *Livingstone's Last Journals* (1874). In this Victorian classic Livingstone emerges as a hero, an anti-slavery crusader, and a martyr. Through careful editing, therefore, Waller secured Livingstone's place in British iconography as a saint and champion of the oppressed but he was economical with the truth when it came to the man himself.

The four-page letter to Waller, dated 5 February 1871 and published for the first time today, reveals Livingstone's state of mind in the months leading up to his famous encounter with Henry Morton Stanley, the correspondent from the *New York Herald* who claims he greeted Livingstone with the famous phrase "Dr. Livingstone, I presume?" Livingstone writes to Waller about his loneliness, his fears about the rapid spread of the cholera epidemic, and the prospects for the abolition of slavery. Fiercely competitive, he is openly critical of the achievements of his fellow explorers Samuel White Baker, Richard Burton, and John Hanning Speke. He also expresses disgust and disillusionment with the British government's policy of laissez-faire in Africa and the Middle East. Moreover, as a doctor experienced in tropical and western medicine, he expresses complete bewilderment about two fatal local conditions: the sudden death of slaves from 'Brokenheartedness', and the pernicious practice of clay- or earth-eating. The letter closes with a prescient farewell to Waller, which ends with the line 'Doubtful if I live to see you again'.

Dr Adrian Wisnicki, project leader, says "Livingstone made his name as an explorer with his sighting of Victoria Falls and his transcontinental African journey of 1852-1856, but logistical problems and conflict with fellow travellers marred subsequent African expeditions. In 1871 Livingstone was at a personal and professional nadir and this is reflected in the letter."

Dr Debbie Harrison, the project's contributing editor and medical historian, adds, "He was also a very sick man. Livingstone was suffering the aftermath of dysentery, fever, pneumonia, and horrific tropical eating ulcers on his feet and legs, which ate through muscle, tendons and bone. His old complaint – severe blood loss from chronic prolapsed haemorrhoids – exacerbated his weak condition. His closing line to Waller indicates his anxious and depressed state of mind. He did not know that in just a few months Stanley would arrive, bringing desperately needed food, medicines and the longed for news from an outside world he thought had forgotten him."

Wisnicki explains the significance of the letter: "*Livingstone's Letter from Bambarre* is the first nineteenth-century British literary work to be captured and enhanced using the multispectral-imaging process. It sets a new standard for the analysis of nineteenth-century manuscripts and is made available as a free resource on *Livingstone Online*, the leading, open-access internet resource for Livingstone's writings. The letter – and the technical process by which it has been digitized – will fascinate the public and be of keen interest to researchers of British Empire, African history, the history of medicine, Victorian literature, and the digital humanities."

Members of the scientific team have worked on previous imaging projects, most notably the Archimedes Palimpsest, palimpsests at St. Catherine's Monastery, and manuscripts at the US Library of Congress, including drafts of the US Declaration of Independence and President Lincoln's Gettysburg Address. Mike Toth of R.B. Toth Associates, an expert in technical studies of cultural objects for museums and libraries, says, "*Livingstone's Letter from Bambarre* demonstrates the breadth and depth of detail we expect to emerge from the diaries. The multispectral imaging process involves illuminating the page with successive wavelengths of light – starting with ultraviolet, working through the visible spectrum, and concluding with infrared. We capture these images digitally and then process them to enhance and suppress selected features of the object. With the letter our team was able to enhance the explorer's faded handwriting and suppress the underlying printed text to enhance Livingstone's previously obscured words. We are now applying the same process to the diaries and other letters from the same period."

Property Manager at the David Livingstone Centre, Karen Carruthers says: “Having taken care of Livingstone’s final diaries for 10 years, it is hugely exciting to uncover what Livingstone wrote on these extracts for the first time. I hope this move inspires a whole new generation of people to discover this fascinating man and his influence on millions of people throughout the world.”

Notes to editors: See separate Q&A sheets for further details

1. The project team: director Adrian S. Wisnicki and medical historian Debbie Harrison represent the pioneering scholarship in Victorian Studies at Birkbeck, University of London; the US team of prominent scientists, led by Mike Toth, includes imaging scientists Keith Knox, Roger L. Easton Jr. and William Christens-Barry, data manager Doug Emery, and camera engineer Ken Boydston.
2. The project would not be possible without the generous funding provided by the US National Endowment for the Humanities (NEH) <http://www.neh.gov> and the British Academy <http://www.britac.ac.uk>
3. The Early Manuscripts Electronic Library will facilitate back-up data storage: <http://emelibrary.org>
4. *Livingstone’s Letter from Bambarre* was purchased in 1966 at Sotheby’s by Peter Beard, the American photographer, who generously made it available to Adrian S. Wisnicki and the readers of *Livingstone Online*.
5. The diary is held at the National Trust for Scotland’s David Livingstone Centre in Blantyre, Scotland: <http://www.nts.org.uk/Property/23>
6. Further portions of the diary and additional letters are held at The National Library of Scotland, which is also the largest repository of Livingstone-related documents in the world: <http://www.nls.uk>
7. Livingstone Online is the leading internet resource for Livingstone primary texts, especially those letters that focus on medical aspects of Livingstone’s life: <http://www.livingstoneonline.ucl.ac.uk>

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Transatlantic Project Retrieves Rare Livingstone Manuscripts

I am terribly knocked up but this is for your own eye only [-] in my second childhood [-] a dreadful old fogie – doubtful if I live to see you again

—David Livingstone to Horace Waller, 5 February 1871

For 140 years, rare manuscripts crucial to our understanding of the last years of the celebrated Victorian explorer and abolitionist David Livingstone in Africa were inaccessible due to their fragility and near-indecipherable script. Now a pioneering transatlantic collaboration among scholars from Birkbeck College (University of London), U.S. imaging scientists, and British and American cultural institutions has begun to make these manuscripts available online, starting with the publication of the revised edition of *Livingstone's Letter from Bambarre* (<http://livingstone.library.ucla.edu/>) by *Livingstone Online* and the UCLA Digital Library Program. The transatlantic collaboration is the first to apply multispectral imaging--a preservation technology previously used to recover erased writing in medieval palimpsests--to restore the text of a nineteenth-century British manuscript. The revised critical edition (2011, orig. 2010) of Livingstone's 1871 letter to his close friend and future editor Horace Waller includes a full transcription of the text, detailed critical notes, an extensive bibliography, an overview of spectral imaging, and a selection of spectral images processed to enhance both text and topographical features.

In February 1871, while searching for the source of the Nile, Livingstone was in ill health, low on supplies, and living in extreme environmental conditions--a virtual prisoner in Bambarre, a village in what is now the eastern part of the Democratic Republic of the Congo. He had also run out of paper and would shortly run out of ink. As a result, when he decided to write to Waller, Livingstone improvised. He used pages torn from a proof copy of the *Proceedings of the Royal Geographical Society* to describe his thoughts on the slave trade, the prospects for commerce and Christianity in the African interior, and relationships of the lake and rivers in Central Africa.

Livingstone's expedient might have provided a short-term solution, but today the letter--and similar documents produced by Livingstone at the time--present serious obstacles to the researcher. The letter's pages are yellowed and brittle, and Livingstone's ink has bled through the paper, in effect creating two layers of superimposed text. The improvised ink used for other documents, such as Livingstone's diary, has faded to the point of invisibility. The problem is also compounded by Livingstone's method of writing, which weaves an unsteady course around the margins of the page before it meanders vertically across the horizontal print of the *Proceedings*. With unintended irony, the letter's disorienting text visually captures Livingstone's frail mental and physical state.

The imaging and formal publication of Livingstone's letter to Waller--from the private collection of the distinguished American photographer Peter Beard--concludes the first phase of an 18-month project to produce a critical edition and spectral image database of the diary and letters Livingstone wrote in the year before his famous meeting with Henry Morton Stanley in late 1871. The project is funded by the U.S. National Endowment for the Humanities and the British Academy. The diary and letters, except for the letter from Peter Beard's collection, are held at the David Livingstone Centre in Blantyre, Scotland and the National Library of Scotland. The two organisations are collaborating with a team of academics and scientists--known as the David Livingstone Spectral Imaging Project--in order to bring these texts to the light of day. The full results of this project will eventually be made available through a unique partnership between the UCLA Library (<http://www.library.ucla.edu/>) and *Livingstone Online* (<http://www.livingstoneonline.ucl.ac.uk/>), the main digital resource for Livingstone's writings. For further details contact the Project Director, Dr. Adrian S. Wisnicki (awisnicki@yahoo.com).

Livingstone press release US version / Embargoed until 12 noon GMT, Tuesday 1 November 2011

Dr Livingstone's lost 1871 'massacre' diary recovered and published by transatlantic academic and scientific team

Discovery rewrites history after 140 years

In Africa 140 years ago David Livingstone, the Victorian explorer, met Henry M Stanley of the New York Herald and gave him a harrowing account of a massacre he witnessed, in which slave traders slaughtered 400 innocent people. Stanley's press reports prompted the British government to close the East African slave trade, secured Livingstone's place in history and launched Stanley's own career as an imperialist in Africa.

Today an international team of scholars and scientists, led by Dr Adrian Wisnicki, Indiana University of Pennsylvania, publishes the results of an eighteen-month project to recover Livingstone's original account of the massacre. The story, found in a diary that was illegible until it was restored with advanced digital imaging, offers a unique insight into Livingstone's mind during the greatest crisis of his last expedition, on which he would die in 1873.

Livingstone's 1871 Field Diary is a free online public resource published by the UCLA Digital Library Program in Los Angeles (<http://livingstone.library.ucla.edu/1871diary/>). The project was made possible by the generous funding and support provided by the National Endowment for the Humanities (<http://www.neh.gov/>), an independent grant-making agency of the US Government dedicated to supporting research, education, preservation, and public programs. The British Academy has also helped fund the endeavour. With these grants, the research and all the data is made available to advance humanities and technology studies across the United States and globally.

The story the diary tells is electrifying. Livingstone had once been a national hero but when he wrote this diary, he had been forgotten by the public and was stranded without supplies in Central Africa. A dedicated writer, he made ink from berry seeds and wrote over the pages of a single copy of the *London Standard* – the precursor to today's *Evening Standard*. Exposed to the African environment, the manuscript deteriorated rapidly and today is virtually invisible to the naked eye.

The diary depicts, in Livingstone's words, 'the unspeakable horror' of the slave trade in what is now the Eastern Democratic Republic of Congo. It provides an eye-witness account of the shocking massacre, perpetrated by armed slave traders in Nyangwe, a Congolese village. The event forced Livingstone to change his travel plans and led to his famous meeting with Stanley. Had Stanley not found Livingstone and greeted him with the words, "Dr. Livingstone, I presume?" the world might never have heard of Livingstone again.

The massacre is one of the most important events in *The Last Journals of David Livingstone* (1874), edited after Livingstone's death in 1873 by his friend Horace Waller. Until now this book was the main source for historians and biographers. However, critical and forensic analysis of the original 1871 text reveals a very different story from Waller's heavily edited version. In particular it sheds light on a heart-stopping moment when Livingstone gazes with 'wonder' as three Arab slavers with guns enter the market in Nyangwe, where 1500 people are gathered, most of them women.

'50 yards off two guns were fired and a general flight took place – shot after shot followed on the terrified fugitives – great numbers died – It is awful – terrible, a dreadful world this,' writes Livingstone in despair as he witnesses the massacre. 'As I write, shot after shot falls on the fugitives

on the other side [of the river] who are wailing loudly over those they know are already slain – Oh let thy kingdom come.'

Dr Wisnicki, assistant professor at Indiana University of Pennsylvania and honorary research fellow at Birkbeck, University of London, says, 'Evidence in the diary suggests that members of Livingstone's party might have been involved in the massacre. Livingstone seems to have considered this possibility and this, together with his failure to intervene, appears to have left him with a profound sense of remorse. In copying over the 1871 diary into his journal, Livingstone decided to rewrite or remove a series of problematic passages. His revised journal account, on which the 1874 book is based, did not reflect his original record. It's taken 140 years to discover Livingstone's original words and reveal the many secrets of the original diary.'

The original account of the massacre is just one of many passages in the diary that is significantly different from the 1874 book. 'Livingstone would never have published this private diary in his own lifetime,' says Dr Wisnicki. 'In particular his attitude to the liberated slaves in his entourage is one of disgust – an attitude greatly at odds with his public persona as a dedicated abolitionist.'

Dr. Wisnicki anticipates that the publication of the 1871 diary will change the way history interprets Livingstone's legacy. 'Instead of the saintly hero of Victorian mythology, the man who speaks directly to us from the pages of his private diary is passionate, vulnerable, and deeply conflicted about the violent events he witnesses, his culpability, and the best way to intervene – if at all.'

Spectral imaging, the process used to recover Livingstone's original text, involves illuminating the manuscript with successive wavelengths of light – starting with ultraviolet, working through the visible spectrum, and ending with infrared. Processed digital images enhanced the selected text.

The scientific and technical team, led by Mike Toth of R.B. Toth Associates, an expert in technical studies of cultural objects for museums and libraries, includes Keith Knox, Roger L. Easton Jr., Bill Christens-Barry, Ken Boydston, and Doug Emery. The Library of Congress provided invaluable support in in system development and technical advice. Together the scholars and scientists involved in this interdisciplinary project help usher in a new era of academic endeavour, in which advanced imaging technology is applied to the study of nineteenth-century manuscripts.

Toth says, 'The results of this diary project, which enhanced Livingstone's faded handwriting and suppressed the underlying printed text, demonstrate the significance of the spectral imaging process for the digital recovery of damaged and old manuscripts. By making the results available online, the project helps preserve the original diary, which is too fragile to be made available to the public.'

For further information contact:

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Notes to editors:

Further analysis, images of the diary and details about collaborating institutions can be downloaded here: <http://www.bbk.ac.uk/news/dr.-livingstones-lost-1871-massacre-diary-recovered>

Academic project team: project director Dr Adrian S. Wisnicki, contributing editor and medical historian Dr Debbie Harrison, and research assistant Kate Simpson, together represent the pioneering Victorian scholarship of Indiana University of Pennsylvania (IUP), Birkbeck, University of London, and Napier University of Edinburgh.

Scientific and technical team: led by Mike Toth of R.B. Toth Associates, an expert in technical studies of cultural objects for museums and libraries, the team comprises imaging scientists Keith Knox, Roger L. Easton Jr. and William Christens-Barry, data manager Doug Emery, and camera engineer Ken Boydston. Members of the scientific team have worked on previous projects in support of major manuscript studies, most notably the Archimedes Palimpsest (www.archimedespalimpsest.org) at the Walters Art Museum, palimpsests at St. Catherine's Monastery, and manuscripts at the US Library of Congress, including drafts of the US Declaration of Independence and President Lincoln's Gettysburg Address. The scientific and technical team was supported by the US Library of Congress and in particular by Dr Fenella France.

Project sponsors: The project would not have been possible without the generous funding provided by the US National Endowment for the Humanities (<http://www.neh.gov>) and also by the British Academy (<http://www.britac.ac.uk>). The NEH has previously funded the Islamic and Western manuscript imaging at the Walters Art Museum mentioned above.

Digital publishers: The UCLA Digital Library Program (<http://www.library.ucla.edu/libraries/2627.cfm>), the publisher of the diary, coordinates the creation, management, and delivery of digital content in support of the UCLA Library's mission and goals. The program, led by Stephen Davison, digitizes and publishes online content drawn from the university's collections and engages with U.S. and international partners to build innovative digital collections, services, and technologies.

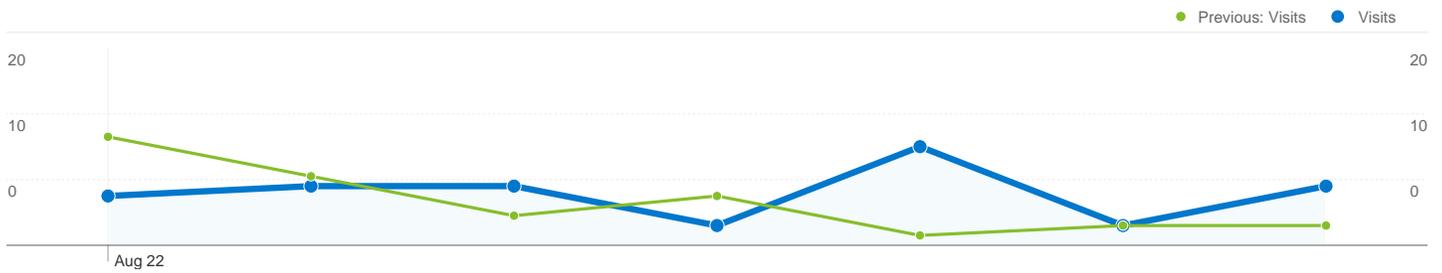
Diary manuscript: The manuscript has been carefully preserved by the National Trust for Scotland's David Livingstone Centre in Blantyre (<http://www.nts.org.uk/Property/23>). Further segments of the diary and additional letters are held at the National Library of Scotland, the largest repository of Livingstone documents in the world (<http://www.nls.uk>). These institutions collaborated with the project team to help bring the 1871 diary to the light of day.

Press Coverage for the David Livingstone Spectral Imaging Project

- "Zanzibar Slave Slaughter Comes Into Sharp Focus." *Tanzania Daily News* 22 Jan. 2012.
<http://dailynews.co.tz/index.php/features/popular-features/1185-zanzibar-slave-slaughter-comes-into-sharp-focus> (accessed 23 Jan. 2012).
- "Recovering Livingstone's Lost 1871 'Massacre' Diary." *The Baobab Tree* Wint. 2012:10-12. *The Baobab Tree* is the UK Foreign Office's newsletter for Africa.
- Radio Interview. *ABC Radio Australia* 14 Nov. 2011.
- Henry Fountain. "Restored: Fading Account From the Heart of Africa." *New York Times* 7 Nov. 2011.
http://www.nytimes.com/2011/11/08/science/restored-livingstones-fading-notes-from-africa.html?_r=1&ref=science (accessed 7 Nov. 2011).
- Gillian Provan. "South Lanarkshire volunteers and councillors get an insight into David Livingstone." *STV Hamilton* 7 Nov. 2011. <http://local.stv.tv/hamilton/news/27028-south-lanarkshire-volunteers-and-councillors-get-an-insight-into-david-livingstone/> (accessed 15 Nov. 2011).
- Patricio Lazcano. "Descifran diario de David Livingstone que contradice su histórica imagen." *La Tercera* (Chile) 6 Nov. 2011: 60-61. <http://papeldigital.info/lt/index.html?2011110601#> (accessed 11 Nov. 2011)
- Radio interview. "Moncrieff with Sean Moncrieff." *Newstalk Radio Ireland* 8 Nov. 2011.
- Marea Donnelly. "Livingstone's hand in slave massacre." *The Daily Telegraph* (Australia) 4 Nov. 2011: 109.
- Darren Devine. "New light shed on adventurer Henry Morton Stanley suggests he may have helped end brutal slave trade." *Wales Online* 3 Nov. 2011. <http://www.walesonline.co.uk/news/wales-news/2011/11/03/new-light-shed-on-adventurer-henry-morton-stanley-suggests-he-may-have-helped-end-brutal-slave-trade-91466-29710773/> (accessed 5 Nov. 2011).
- Sarah Bruce. "Now we can see Livingstone's African diary in a new light." *Scottish Daily Mail* 2 Nov. 2011: 31.
- Lucinda Cameron. "Explorer's 140-year-old diary made legible by scientists." *The Irish News* 2 Nov. 2011: 22.
- Andy Coghlan. "Paper scans unmask Livingstone's fury at slave killing." *New Scientist* 2 Nov. 2011.
<http://www.newscientist.com/article/dn21115-paper-scans-unmask-livingstones-fury-at-slave-killing.html> (accessed 5 Nov. 2011).
- Auslan Cramb. "Why we may be wrong to presume Dr Livingstone was a hero." *The Daily Telegraph* 2 Nov. 2011: 10.
- Ben Macintyre. "Description of massacre provoked outrage in Parliament." *The Times* 2 Nov. 2011: 27.
<http://www.thetimes.co.uk/tto/news/uk/article3213317.ece> (accessed 6 Nov. 2011).
- George Mair. "Livingstone Slave Horror Revealed." *Daily Record* 2 Nov. 2011: 22.
<http://www.dailyrecord.co.uk/news/editors-choice/2011/11/02/horror-of-scots-explorer-david-livingstone-at-slave-massacre-uncovered-in-lost-diary-86908-23532303/> (accessed 5 Nov. 2011).
- Chris Marshall. "Dr. Livingstone's lost diary text, I presume." *The Scotsman* 2 Nov. 2011: 25.
http://www.scotsman.com/news/education/livingstone_s_lost_diary_text_i_presume_1_1942190 (accessed 5 Nov. 2011).
- Phil Miller. "Livingstone's account of slave massacre revealed." *The Herald* (Glasgow) 2 Nov. 2011: 8.
<http://www.heraldscotland.com/news/home-news/livingstone-s-account-of-slave-massacre-revealed-1.1132529?localLinksEnabled=false> (accessed 5 Nov. 2011).

- Rod Mills. "Slave secret of Dr. Livingstone." *The Express* 2 Nov. 2011: 30.
<http://www.express.co.uk/posts/view/281199> (accessed 5 Nov. 2011).
- Blakely, Rhys. "Dr Livingstone, not quite the saint we presumed." *The Times* 2 Nov. 2011.
<http://www.thetimes.co.uk/tto/news/uk/article3213300.ece> (accessed 2 Nov. 2011).
- Simon Tomlinson. "Dr Livingstone lied, scientists presume: Spectral imaging uncovers discrepancies in explorer's account of slave massacre." *Mail Online* 2 Nov. 2011.
<http://www.dailymail.co.uk/sciencetech/article-2056528/David-Livingstone-Discrepancies-explorers-account-Zanzibar-slave-massacre.html?ito=feeds-newsxml> (accessed 5 Nov. 2011).
- Mike Wade. "Dr. Livingstone, not quite the saint we presumed." *The Times* 2 Nov. 2011: 27.
<http://www.thetimes.co.uk/tto/news/uk/article3213300.ece> (accessed 6 Nov. 2011).
- News feature. *BBC TV* 1 Nov. 2011.
http://www.bbc.co.uk/iplayer/episode/b016qyg4/Reporting_Scotland_01_11_2011/ (accessed 1 Nov. 2011).
- Video broadcast: "Livingstone Diary." *Deadline News* 1 Nov. 2011
<http://www.deadlinenews.co.uk/2011/11/01/livingstone-diary/> (accessed 1 Nov. 2011).
- Radio interview. *BBC Radio Scotland* 1 Nov. 2011. <http://www.bbc.co.uk/programmes/b016lw5l>
 (accessed 1 Nov. 2011).
- Radio interview. *CBC Radio* 2 Nov. 2011. <http://www.cbc.ca/asithappens/> (accessed 5 Nov. 2011).
- News feature. "Dagboek David Livingstone ontcijferd." *Radio 1* (Belgium) 2 Nov. 2011.
<http://www.radio1.be/programmas/nieuwe-feiten/dagboek-david-livingstone-ontcijferd> (accessed 5 Nov. 2011).
- "Experts shed light on David Livingstone massacre diary." *BBC News* 1 Nov. 2011.
<http://www.bbc.co.uk/news/uk-scotland-edinburgh-east-fife-15536564> (accessed 1 Nov. 2011).
- "Explorer David Livingstone's diary unveiled for the first time." *STV* 1 Nov. 2011.
<http://news.stv.tv/scotland/east-central/277152-explorers-diary-unveiled-for-the-first-time/>
 (accessed 1 Nov. 2011). Article and video broadcast.
- Laura Cummings. "Out of paper I presume Doctor Livingstone?" *Evening News* (Edinburgh). 1 Nov. 2011: 3. http://www.scotsman.com/edinburgh-evening-news/edinburgh/around-the-capital/scientists_work_looks_set_to_rewrite_history_of_famous_scots_explorer_1_1941086
 (accessed 1 Nov. 2011).
- Jen Lavery. "Dear diary, 400 slaves slaughtered." *Metro* (UK) 1 Nov. 2011: 24.
- Raphael Satter. "Newly deciphered diary muddles Livingstone legend." *Associated Press* 1 Nov. 2011.
<http://www.google.com/hostednews/ap/article/ALeqM5iEVeAhLGODJiVWWntkV1r35NJdBw?docId=24ad19e8b623415bb87e25b612506707> (accessed 1 Nov. 2011). Carried by over 150 media sites worldwide.
- Mark Schrope. "Dr. Livingstone's diary on 19th-century Africa, now uncensored." *Washington Post* 1 Nov. 2011: C1. http://www.washingtonpost.com/lifestyle/style/dr-livingstones-diary-on-19th-century-africa-now-uncensored/2011/10/31/gIQAUsB2aM_story.html (accessed 5 Nov. 2011).
- "Dr. Livingstone, I Presume? Decoding an Explorer's Personal Papers." *The Explorers Journal* Fall 2011: 9.
- Vic Rodrick. "Shedding New Light on Dr Livingstone's Diary." *Daily Mail* (London) 2 May 2011: 23.
- Short Radio Documentary. "Click On." *BBC Radio 4*, 18 Apr. 2011. <http://www.bbc.co.uk/programmes/b010dk1z> (accessed 18 Apr. 2011).
- Anna Maria Gillis. "Livingstone in a New Light." *Humanities Magazine* 31:5 (Sept./Oct. 2010).
<http://www.neh.gov/news/humanities/2010-09/Livingstone.html> (accessed 22 Jan. 2011).

- "The Secret Files: Out of Africa." *Holland Herald* Sept. 2010. <http://holland-herald.com/2010/09/the-secret-files/> (accessed 8 Sept. 2010). The monthly in-flight magazine of KLM Airlines, with an estimated global readership of 1.25 million people.
- Annabel Venning. "The Dark Side of Dr Livingstone: A Fascinating New Letter Casts the Great Explorer in a Very Different Light." *Daily Mail* (London) 29 July 2010. <http://www.dailymail.co.uk/news/article-1298546/Dark-Dr-David-Livingstone-New-letter-casts-explorer-different-light.html> (accessed 29 July 2010).
- Irene Meichsner. "Held mit Depression: Forscher entschlüsseln privaten Brief des Afrikareisenden David Livingstone." *Kölner Stadt-Anzeiger Magazin* 24/25 July 2010. <http://www.ksta.de/html/artikel/1278663541481.shtml> (accessed 24 July 2010).
- Short Television Documentary. "London Tonight," ITV 1, 19 July 2010. ITV is the oldest commercial television network in the UK.
- Jerome Taylor. "The Private Thoughts of Dr Livingstone, I Presume." *The Independent* 3 July 2010. <http://www.independent.co.uk/news/uk/home-news/the-private-thoughts-of-dr-livingstone-i-presume-2017249.html> (accessed 3 July 2010).
- Aussian Cramb. "Shedding Light on History: Scientists Decipher Dr. Livingstone's Last letters." *Daily Telegraph* 3 July 2010: 17.
- Raphael Satter. "David Livingstone Letter Deciphered At Last." *The Associated Press* 2 July 2010. <http://abcnews.go.com/Technology/wireStory?id=11071708> (accessed 2 July 2010). This AP story has been carried by over 140 print and online news outlets around the world.
- Andy Coghlan. "Dear diary, I am sick to death . . . David Livingstone." *New Scientist* 2 July 2010. <http://www.newscientist.com/article/dn19119> (accessed 2 July 2010).
- Mike Wade. "From the Congo in Berry Juice, David Livingstone's Last Letters Come to Light." *The Times* (Scotland) 2 July 2010. <http://www.thetimes.co.uk/tto/news/uk/scotland/article2583818.ece> (accessed 2 July 2010).
- "Secrets of Livingstone's Last Letter Finally Revealed." *STV* 2 July 2010. <http://news.stv.tv/scotland/185283-secrets-of-livingstones-last-letter-finally-revealed/> (accessed July 2, 2010).
- "David Livingstone's 'Lost Letter' Deciphered." *BBC News* 2 July 2010. <http://www.bbc.co.uk/news/10459263> (accessed 2 July 2010).
- Jenny Percival. "David Livingstone's Last Letters Deciphered." *The Guardian* 2 July 2010. <http://www.guardian.co.uk/uk/2010/jul/02/david-livingstone-last-letters-deciphered> (accessed 2 July 2010).
- "Researchers Reveal Dr Livingstone's Darkest Hour Through Lost Letters." Birkbeck, University of London July 2, 2010. <http://www.bbk.ac.uk/news/news-releases/researchers-reveal-dr-livingstones-darkest-hour-through-lost-letters> (accessed 2 July 2010). Includes link to full press pack.
- Short Feature. BBC Radio Scotland. 1 July 2010. <http://www.bbc.co.uk/programmes/b00sw6cr> (accessed 1 July 2010).
- Jennifer Howard. "Archive Watch: Dr. Livingstone's Diary, I Presume." *The Chronicle of Higher Education: Wired Campus*. 3 May 2010. <http://chronicle.com/blogPost/Archive-Watch-Dr/23677/> (accessed 3 May 2010).



Site Usage

37 Visits

Previous: 31 (19.35%)

37.84% Bounce Rate

Previous: 48.39% (-21.80%)

219 Pageviews

Previous: 76 (188.16%)

00:03:30 Avg. Time on Site

Previous: 00:00:51 (313.49%)

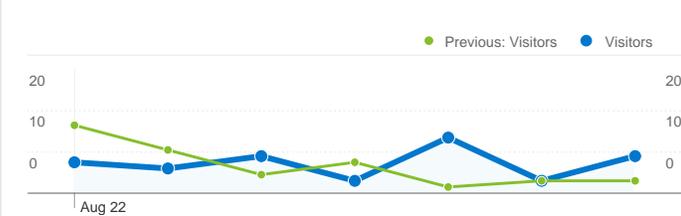
5.92 Pages/Visit

Previous: 2.45 (141.43%)

81.08% % New Visits

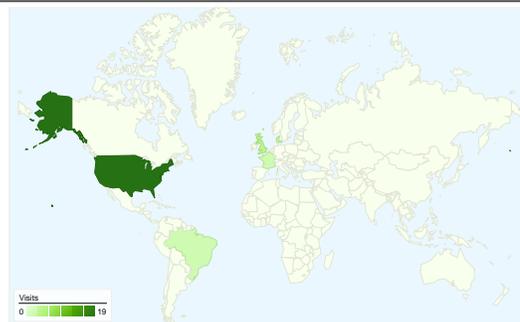
Previous: 87.10% (-6.91%)

Visitors Overview

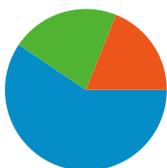


Visitors
34

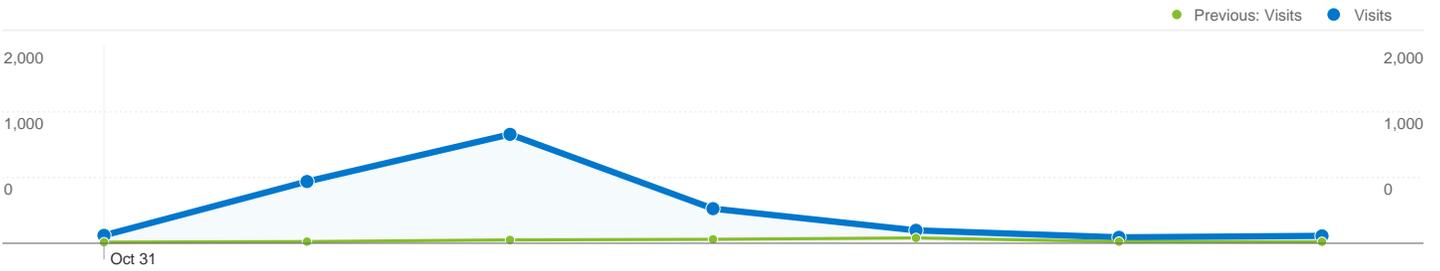
Map Overlay



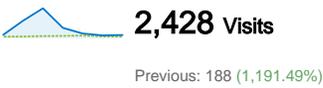
Traffic Sources Overview



- **Referring Sites**
22.00 (59.46%)
- **Direct Traffic**
8.00 (21.62%)
- **Search Engines**
7.00 (18.92%)



Site Usage

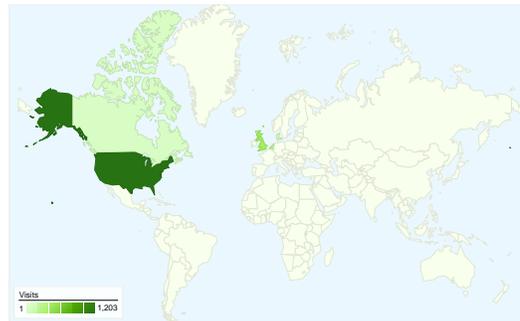


Visitors Overview

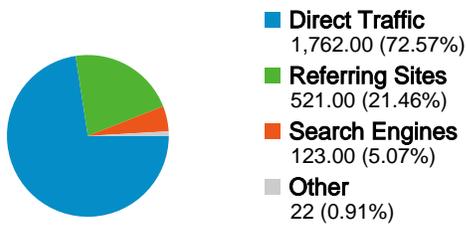


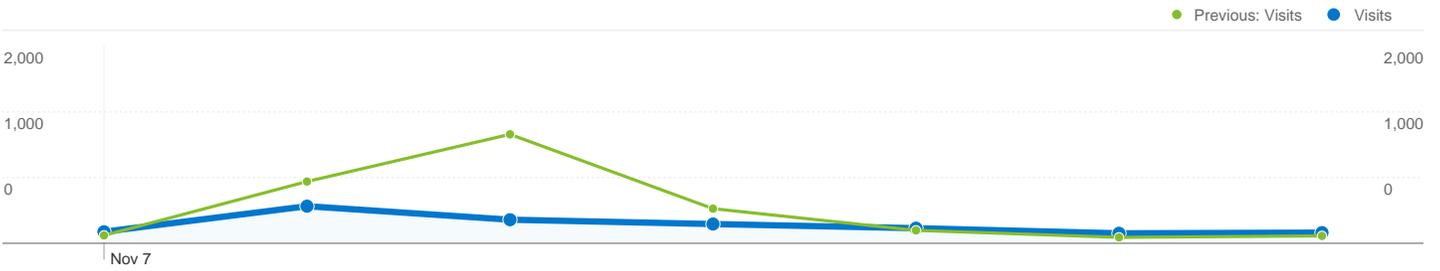
Visitors
2,193

Map Overlay



Traffic Sources Overview





Site Usage

1,289 Visits

Previous: 2,428 (-46.91%)

49.26% Bounce Rate

Previous: 54.12% (-8.97%)

3,860 Pageviews

Previous: 6,047 (-36.17%)

00:02:38 Avg. Time on Site

Previous: 00:02:20 (12.35%)

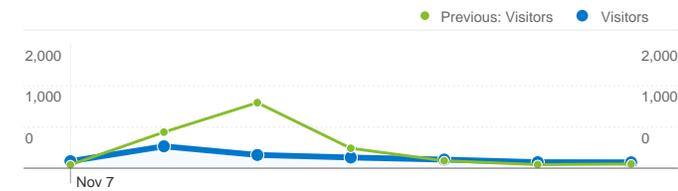
2.99 Pages/Visit

Previous: 2.49 (20.24%)

84.79% % New Visits

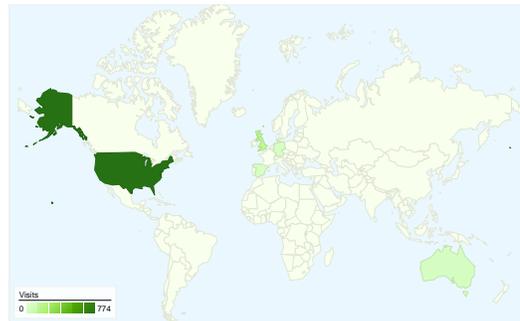
Previous: 89.33% (-5.08%)

Visitors Overview

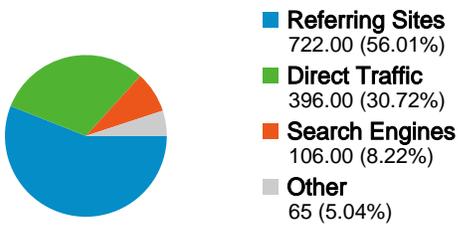


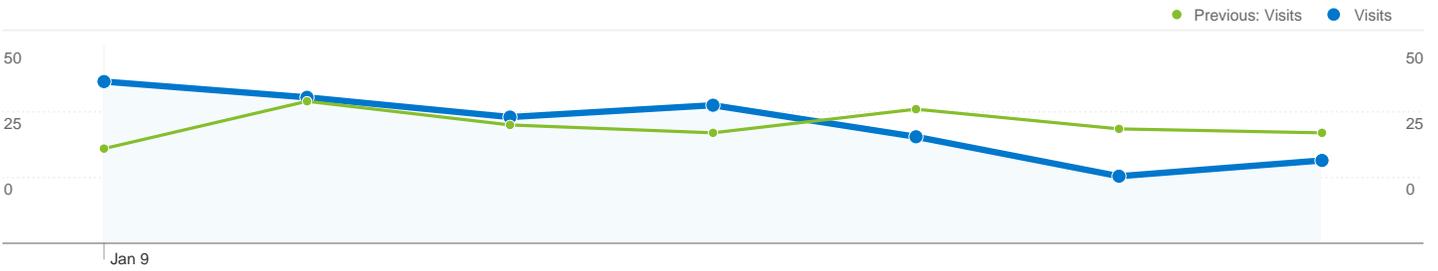
Visitors
1,123

Map Overlay



Traffic Sources Overview





Site Usage

210 Visits

Previous: 209 (0.48%)

60.00% Bounce Rate

Previous: 53.11% (12.97%)

683 Pageviews

Previous: 647 (5.56%)

00:03:40 Avg. Time on Site

Previous: 00:02:59 (23.03%)

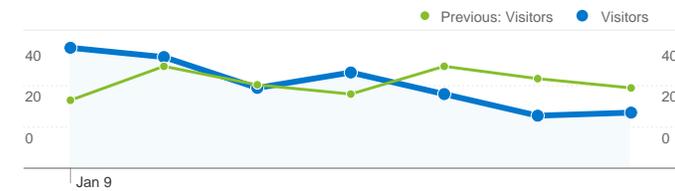
3.25 Pages/Visit

Previous: 3.10 (5.06%)

72.38% % New Visits

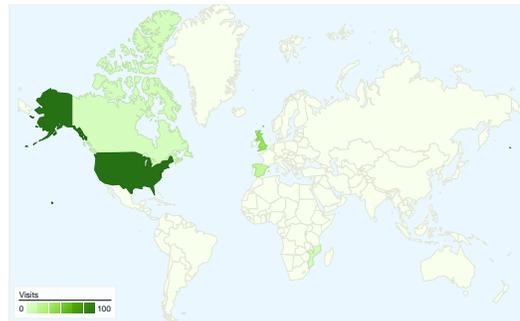
Previous: 86.12% (-15.96%)

Visitors Overview



Visitors
173

Map Overlay



Traffic Sources Overview

